



Investigating the formulation and implementation of circular economy policies in the EU regional context – a policy Delphi study

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Dedication

To my grandmother Gjurgja Jovanova who passed me the love for the pen and paper from a very young age and never stopped believing in me.

Abstract

Regions are the most important administrative units of the EU's development policies and so far, have been extensively used for framing and implementing strategic priorities. However, when it comes to regional implementation of the circular economy (CE), there is lack of systematicity both in academic literature and policy documents. Therefore, this study is proposing regions as the optimal scale for CE adoption; due to their controllable economic systems, tactical intermediate position between national and local levels, their deep knowledge and understanding of their local territories, capacities, and ability to mobilise relevant stakeholders. Within this context, this empirical study is focusing on the formulation and implementation of CE policies at the regional level. More specifically, to investigate whether Smart Specialisation Strategies (S3) influence the adoption of CE policies at the regional level and explore the influence of institutional pressures on the implementation of regional CE policies. In order to address the main aim, a four-stage policy Delphi study was designed, targeting regional policymakers and experts in the field of CE and S3. Initially, the nomination and selection of the experts was performed, followed by a brief online survey distribution. Afterwards, 19 semi-structured individual interviews followed, and the respective transcripts were examined using template analysis. Finally, the findings were validated through distributing Policy Briefs to previous participants and obtaining their feedback, which refined the findings. A conceptual framework was ultimately developed, containing the final propositions. This thesis has found that generally, the EU measures will need to consider the protagonist role of the regions in many vital aspects of the CE transition. The emerging findings point out to the importance of effective multi-level governance mechanisms and supportive institutional environment as conducive for the development and realisation of the CE initiatives. Additionally, the incontestable links between S3 and CE were corroborated, as well as the strong arguments for adopting a place-based approach for the CE transition. However, the S3 and CE nexus proved to be less deterministic, as concerns regarding the potential risk of regional lock-ins and path dependency issues were also raised. Alongside the theoretical contribution, the findings of this research will have practical implications as well; findings which could be of interest for policymakers at different levels, in terms of decision making and devising regional policies, as well as for practitioners for encouraging bottom-up initiatives.

Declaration

I, Sanja Arsova, confirm that the Thesis is my own work. I am aware of the University's Guidance on the Use of Unfair Means (www.sheffield.ac.uk/ssid/unfair-means). This work has not previously been presented for an award at this, or any other, university.

The following academic publications arose from the thesis:

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Chapter one: Introduction

1.1 Research Context

Circular economy (henceforth CE) is perceived by policy development agencies and business associations as an impending paradigm shift, ultimately culminating in industrial transformations (Korhonen et al., 2018). However, concerns have been expressed regarding the apolitical essence of the prevalent approach of presenting CE (Valenzuela and Böhm, 2017), and the probably intentionally nebulous conceptualisation of the specifics about *“how such a Copernican revolution the way we produce and consume would happen”* (Genovese and Pansera, 2020). The tendency of the overall sustainability transformation strategies, including the ones underpinned by the CE concept, to encounter the challenge of surpassing inertia and path dependency has been also put forward (Turnheim et al., 2015). This has heightened the need of formulating effective transitional policies towards the CE, forming new socio-technical systems (Nohra et al., 2020).

According to Henrysson and Nuur (2021), the predominant literature and policy discussions have taken a technological and industrial purview; however, the cardinal point of success of the CE model relies heavily on the relational dynamics which underlie industrial, regional, and national development. A specific socio-technical regime, like the CE, is conditioned by local and regional factors (Henrysson and Nuur, 2021) and the corresponding local institutional arrangements avail sub-national territories to embark on a sustainable journey to economic development (Rodríguez-Pose, 2013). This is contributed to the more efficient functioning of these institutional arrangements at the local and regional scale, as the national scale is perceived to be secluded and detached to successfully mobilise stakeholders (Rodríguez-Pose, 2013).

As put forward by Strat et al (2018), the regional CE and their interconnection are the starting point for ultimately achieving a functional, global CE. In this context, several studies highlight the importance of regions, (henceforth level 2 of the EU Nomenclature of Territorial Units for Statistics (NUTS 2) is used when referring to regions), in supporting the implementation of CE-related EU and national strategies, laws and regulations and coordinating local actors, including Arsova et al. (2022), Arsova et al. (2021), Silvestri et al. (2020) and Barbero and Pallaro (2018). Nevertheless, limited number of studies are exploring the adoption of the CE

on the regional scale (Arsova et al., 2022; Arsova et al., 2021; Scarpellini et al., 2019). In this context, this thesis attempts to address these under investigated areas and enrich the knowledge base on the formulation and implementation of CE policies at the European regional level. More specifically, the main research aim and associated research questions which emerged from the findings of the literature review stream and were consequently corroborated with the grey literature analysis findings are:

Research aim: *To investigate whether Smart Specialisation Strategies (S3) influence the adoption of circular economy policies at the regional level.*

- **RQ1:** How does Smart Specialisation Strategies (S3), as (normative) institutional pressures, influence the adoption of circular economy policies at the regional level? In that context, does S3 impel the adoption of circular economy policies at the regional level, or in contrary it constitutes a form of lock-in which could even impede a region to adopt circular economy policies?
- **RQ2:** What is the corresponding impact on regional performance across a number of economic, social, and environmental metrics, of selected EU regions?
- **RQ3:** What other institutional pressures, normative, coercive, and mimetic, are influencing the adoption of circular economy policies at the regional level?

1.2 Thesis outline

The overall structure of the thesis is presented in **Figure 1**, and **chapters 2 to 6** are summarised below.

Chapter 2 provides context to the thesis by reviewing the existing body of knowledge using the systematic literature review method. After presenting the rigorous process of the review, three types of analysis are conducted, descriptive, bibliometric, and content analysis. The main findings emerging from the literature stream are presented ultimately, along with the main limitations of the systematic literature review.

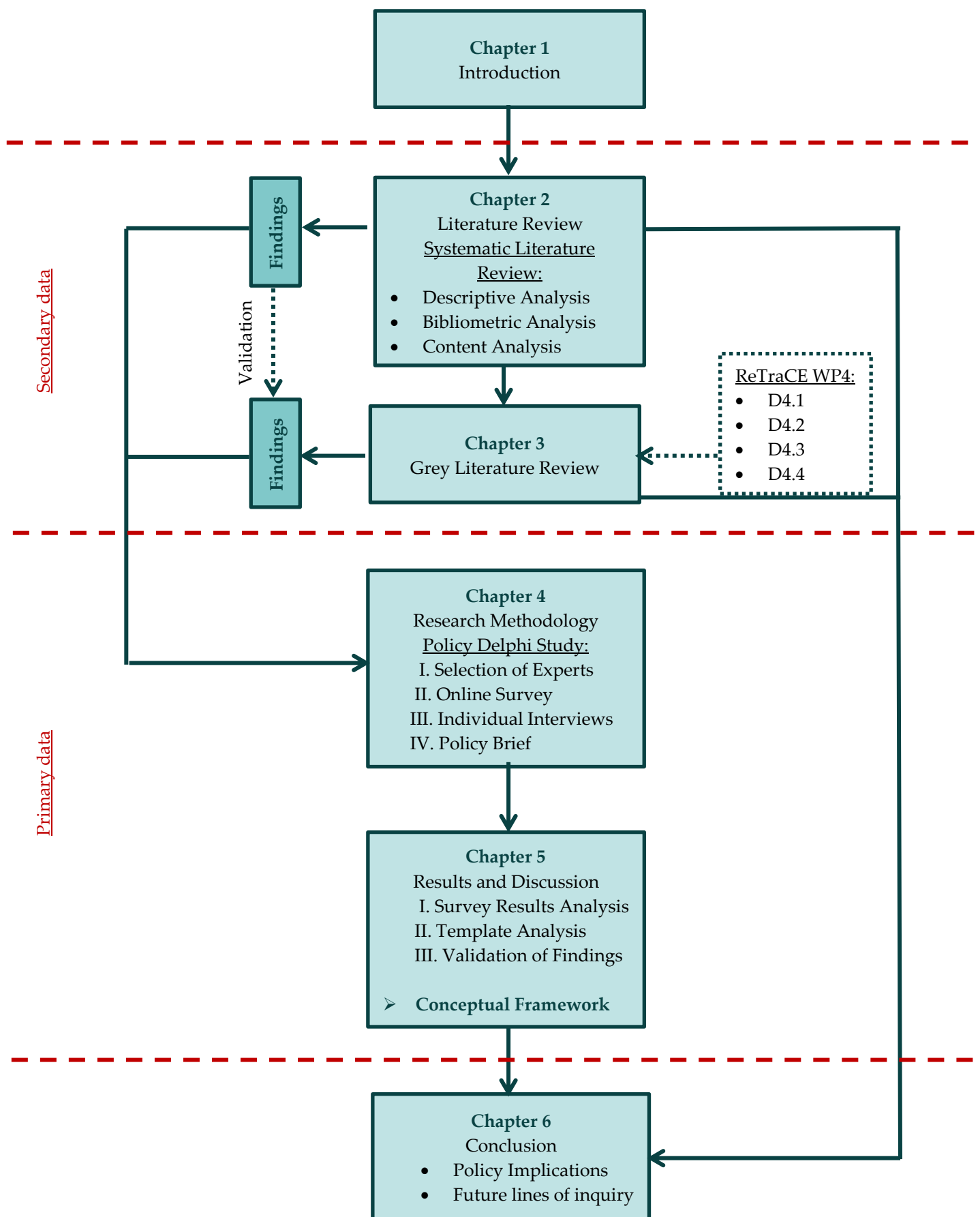


Figure 1: Thesis outline

Chapter 3 postulates the practical perspective of the research topic, therefore grey literature review is performed. This chapter is informed predominantly by the research done within the [WP4](#) of the [ReTraCE Project](#), the four related technical reports, aiming to explore the regional development policies supporting the CE transition. Namely, some of the main EU policies are investigated, and the focus is put on eight selected regions, investigating their CE and S3 policies. The findings of this chapter are validating and enriching the emerging findings from the literature review.

Chapter 4 initially presents the main research aim and research questions of the study, and the selected theoretical framework of the research, the institutional theory. Afterwards, it explains the carefully designed research methodology to address the main research aim and research questions. Namely, a four-stage policy Delphi study is being designed. Phase one included nomination and selection of policy experts while in the second phase a brief online survey is being delivered to policy experts in regional administrations mostly. In the third phase individual interviews with regional policy experts are being conducted in order to explore deeper the initial results from the survey. The results from both phases are then summarised in a form of Policy Brief and distributed to the participants from phase two and three, in order to corroborate them. The main limitations of the selected research methods and data analysis procedures are introduced as well.

Chapter 5 has twofold goals, first to present the results from the policy Delphi study, and second to present the conceptual framework emerging from the research overall. Therefore, the results from the survey are analysed initially, which are followed by a detailed and very structured template analysis of the interview transcripts. Finally, the feedback received on the Policy Briefs is also incorporated. A discussion section follows, where all emerging findings are incorporated, and graphically illustrated in a conceptual framework with the final propositions.

Chapter 6 is providing the concluding remarks, as well as the main policy implications from the thesis. Futures lines of inquiries are also suggested.

Chapter two: Literature Review

2.1 Systematic literature review process

A literature review was conducted to explore the existing knowledge base and evaluate the pertinent intellectual territory. To circumvent the limitations and inherent biases of the traditional narrative literature review (Tranfield et al., 2003), a systematic literature review method was chosen. This entails the adoption of a procedure that is replicable, scientific, and transparent, while ensuring an audit trail of the reviewers' decisions, procedures, and conclusions (Tranfield et al., 2003). The systematic review approach has been frequently used in the field of CE (Goyal et al., 2021; Gregorio et al., 2018; Homrich et al., 2018; Merli et al., 2018; Prieto-Sandoval et al., 2018). Therefore, to achieve the aim described in **section 1.1**, the process began with the systematic review, synthesising the current academic literature on implementing the CE at the regional level, critically analysing, and evaluating the research sources, and revealing the research gaps. To the best of the researchers' knowledge, this is the first attempt to provide a holistic systematic literature review in this research area.

➤ *Databases used*

The review was performed using SCOPUS and Web of Science (WoS), the most comprehensive scientific databases of peer-reviewed journals. According to Mongeon and Paul-Hus (2016), Abrizah et al. (2013), Chadegani et al. (2013), Bar-Ilan (2010) and Vieira and Gomes (2009) these two databases are the most widely used in literature search activities and they also facilitate the execution of an attested bibliometric analysis (de Oliveira et al., 2018; Merli et al., 2018).

➤ *Search strategy*

The review was performed by adapting the procedure initially proposed by Tranfield et al. (2003) and used by Gregorio et al. (2018) and Prieto-Sandoval et al. (2018) comprising three stages: planning, execution, and reporting and dissemination. The customised process is shown in **Figure 2** as a flow diagram, outlining the six-step process and search methodology. This adjusted process covers the first two stages proposed by Tranfield et al. (2003) and is explained in the following paragraphs. The final stage of reporting and dissemination of the results and analysis is presented in **section 2.2**.

Step I: Identification

The first step was a keyword-based search in the SCOPUS and WoS databases. A compounded three-level keyword structure was prepared (**Table 1**). The first level of the keywords was intended to capture the papers discussing CE and other closely related concepts. The second level was intended to include papers related to the regional level, and the third level concerned policy-related papers. To identify the papers at the intersection of these three levels – and to capture the relevant sources on CE at the regional level, with a focus on policy development – a dataset combining the three levels' keywords was created (**Figure 3**). In total, 8,963 potentially relevant articles were retrieved. The details of the search protocols are provided in **Table 2**.

Step II: Automatic screening

The initial data set was then automatically screened, based on four criteria. These criteria¹ and results are shown in **Figure 2**. The cut-off date for data extraction, and therefore inclusion in terms of publishing is 13th May 2021. A total of 1,897 papers proceeded to the third stage.

Integrated three-level keyword structure	Level 1: Context keywords (‘Circular Economy’ OR ‘CE’ OR ‘circular’ OR ‘closed loop’ OR ‘Industrial Ecology’ OR ‘Industrial Symbiosis’ OR ‘Eco-Industrial Parks’)	Scopus: 753,774 WoS: 519,239
	Level 2: Regional level keywords AND (‘region’ OR ‘regional’ OR ‘meso level’ OR ‘macro level’ OR ‘regional development’)	Scopus: 4,844,823 WoS: 2,598,554
	Level 3: Policy development keywords AND (‘policy’ OR ‘policies’ OR ‘regulation’ OR ‘legislation’ OR ‘directive’ OR ‘strategy’ OR ‘government’ OR ‘governance’ OR ‘institutions’)	Scopus: 7,646,196 WoS: 4,052,505

Table 1: Integrated three-level keyword structure

¹ Relevant subject areas for Scopus: Environmental Science, Social Sciences, Energy, Business/Management/Accounting, Multidisciplinary, Economics/Econometrics/Finance, while relevant subject areas for WoS: Environmental Sciences, Area Studies, Engineering, Environmental, Green Sustainable Science Technology, Social Sciences Interdisciplinary, Development, Environmental Studies, Management, Economics, Ecology, Multidisciplinary Sciences, Urban Studies, Regional Urban Planning, Business, Engineering Industrial/Manufacturing/ Multidisciplinary, Geosciences Multidisciplinary

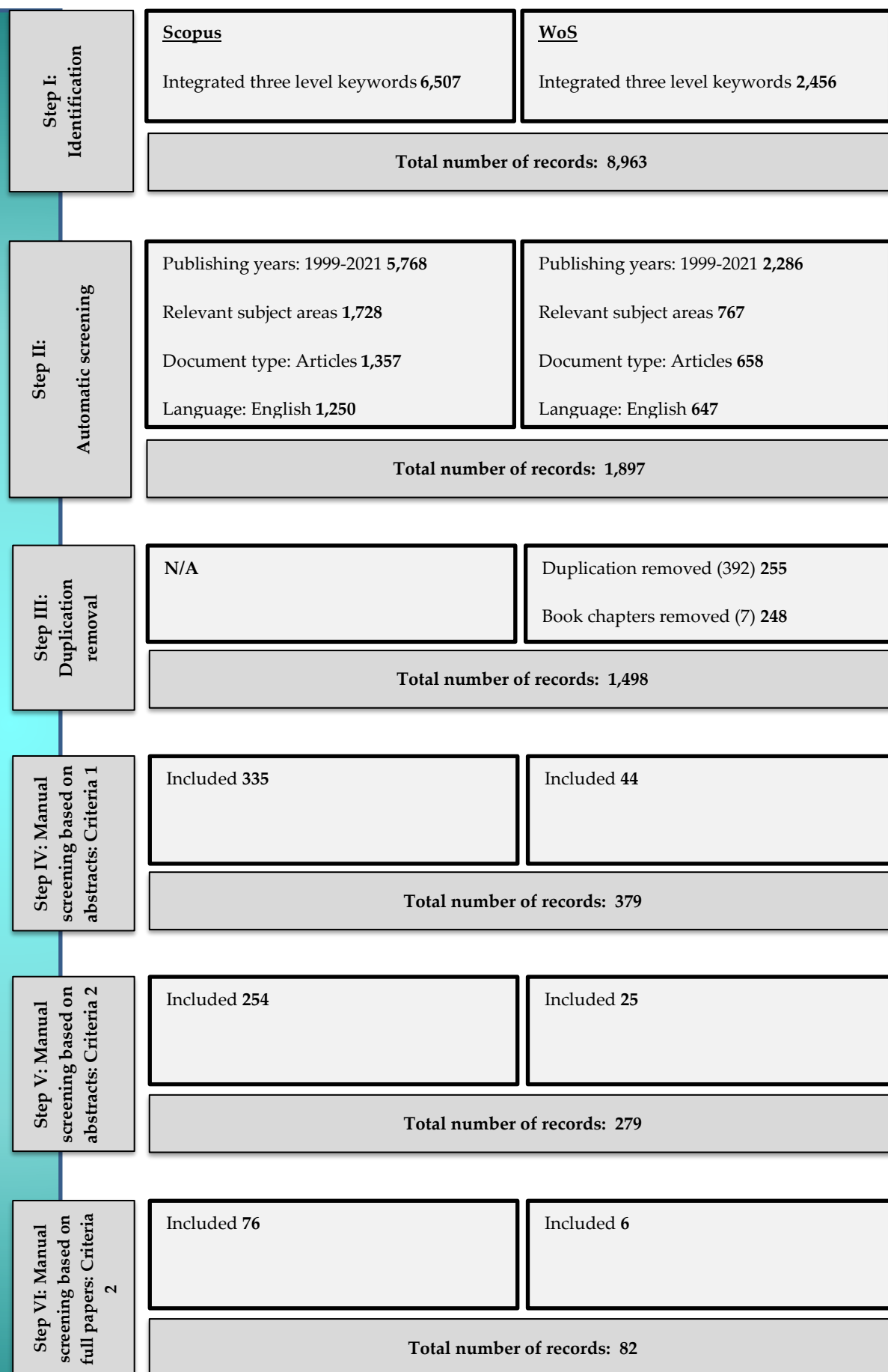


Figure 2: Systematic literature review process - flow diagram

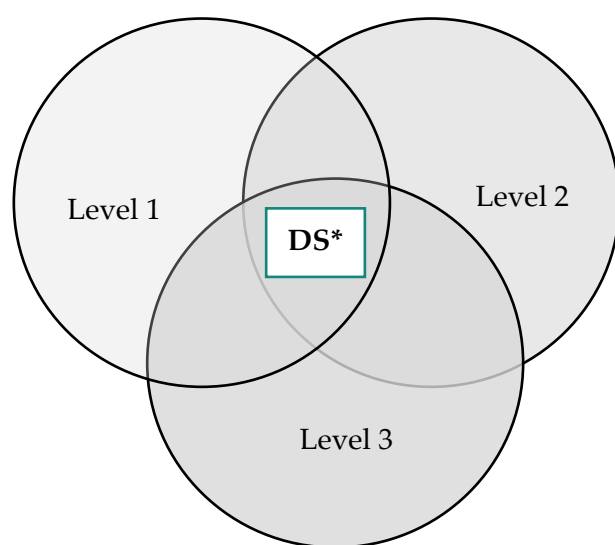


Figure 3: Integrated three-level keyword structure (*DS: Data Set)

Database	Search Field	Search Type	Collection used
Scopus	Article title, Abstract, Keywords	Advanced	
WoS	Topic	Advanced	WoS Core Collection (1900-present)

Table 2: Search protocol

Step III: Duplication removal

In this stage, the duplicates from the two databases were removed using VLOOKUP Excel formulae. A total of 392 duplicate papers were removed, and an additional seven were eliminated since they were book chapters. A total of 1,498 papers went for further processing.

Step IV: Manual screening based on abstracts – Criterion 1

To identify only those papers related to CE, a manual screening of the abstracts was performed based on the criterion below.

⇒ *Criterion 1: Is the paper related to circular economy implementation?*

For the purposes of a systematic and organised evaluation, four categories were developed (**Table 3**), and only 379 articles proceeded to step V.

Categories	Included/Excluded	Scopus	WoS
Unrelated fields (e.g. agriculture, migration, education) or purely scientific and technical background	Excluded	692	152
Marginal relevance to the research area, focusing on carbon management, externalities, water scarcity	Excluded	223	52
Discussing closely related topics to CE, such as industrial ecology, industrial symbiosis, waste management	Included	179	35
Discussing CE, green economy, and decoupling	Included	156	9

Table 3: Categories developed for Step IV

Step V: Manual screening based on abstracts – Criterion 2

As the level of analysis was regional, a second manual screening of the abstracts was completed based on the following criterion:

⇒ *Criterion 2: Is the paper looking at regional circular economy implementation or provides some regional considerations?*

Again, three categories were developed (**Table 4**); and from this stage, 279 papers proceeded to the final stage.

Categories	Included/Excluded	Scopus	WoS
Closely related concepts and CE but on other levels	Excluded	81	19
Tackling closely related issues to CE at the regional level	Included	152	21
Addressing regional CE	Included	102	4

Table 4: Categories developed for Step V

Step VI: Manual screening based on full paper – Criterion 2

In the final stage, a manual screening of the full paper was conducted, again using criterion 2. A decision was made to focus only on implementing CE in European regions, due to the specifics of regions located in Europe, their comparable size, governance mechanisms, institutional structures, and policy development. Additionally, this geographical limitation will avail the researcher to concentrate on a more homogeneous sample rather than include regions located in other countries (e.g. China, Mexico, Russia, Australia) which differ significantly from the main sample being European regions. Taking this into account, four categories were developed and presented in **Table 5**. The final dataset included 82 articles

that either related to CE implementation at the regional level or which discussed regional considerations. These 82 papers are presented in **Appendix A**. Three papers didn't have any specific region therefore the category 'N/A', one paper was focusing on European regions, but other global regions were included, hence the category 'Global', and finally, two papers from UK regions were also part of the final data set. Seven papers were analysing data from several European regions, hence the category 'EU wide' was developed for these articles. These articles were then extensively reviewed and analysed, and the results are shown in the following sections.

Categories	Included/Excluded	Scopus	WoS
Closely related concepts and CE but on other levels	Excluded	162	16
Closely related concepts and CE at the regional level (outside Europe)	Excluded	16	3
Tackling closely related issues to CE at the regional level (Europe)	Included	27	5
Addressing regional CE (Europe)	Included	49	1

Table 5: Categories developed for Step VI

2.2 Reporting and dissemination of results

The final step of the systematic literature review was the reporting and dissemination of the results. The focal point was to recap the findings from the articles and emphasise the key areas in need of further research from academics, practitioners, and policymakers. The data analysis was performed using Microsoft Excel and VOSviewer to visualise the tendencies and relevant findings. The details of the reviewed papers on regional implementation of CE are included in **Appendix A**. Initially, a descriptive analysis was performed using Excel, and the descriptive findings are presented in **section 2.3**. Bibliometric methods, used extensively to present comprehensive groups of the knowledge structure in a particular literature stream (Goyal et al., 2021; Rialti et al., 2019; Homrich et al., 2018; Prieto-Sandoval et al., 2018; Geissdoerfer et al., 2017), were adopted and the results can be found in **section 2.4**. Except Excel, VOSviewer software was used for the bibliometric analysis, as a tool offering relatively easy way to visually represent the bibliometric networks (Fabregat-Aibar et al., 2019).

The descriptive and bibliometric analysis were finally complemented with content analysis, qualitative and quantitative. According to Homrich et al. (2018) the content analysis is allowing an exhaustive understanding of the research constructs and their connections. This

analysis is following an independent and rule-guided procedures to construct replicable and valid inferences by analysing (coding) the characteristics of visual, verbal, and written documents (Khirfan et al., 2020). Moreover, with the use of systemic evaluation, qualitative data can be translated into quantitative analysis, with the purpose to increase the methodological rigor of literature reviews. Generally, this transparent framework is being used with the goal to describe or assess a topic, offer new insights, understanding, interpretations and subsequently a guide for action (Khirfan et al., 2020). Several academics in the CE field used content analysis so far, among which Goyal et al. (2021), Homrich et al., (2018), Prieto-Sandoval et al., (2018), Geissdoerfer et al., (2017) and Kirchherr et al., (2017).

In order to enable the whole process of content analysis, concept matrix was developed (Goyal et al., 2021) following a deductive approach of pre-defined research streams (i.e. structural dimensions). This concept matrix included details of the theories adopted, the territorial mapping of the studies, pillars of the CE, policymaking process, approaches of implementation and mechanism of implementation, drivers and barriers and measurement systems. **Section 2.5** investigates in detail the content of the 82 papers based on those structural dimensions.

2.3 Descriptive findings

2.3.1 Historical series

As shown in **Figure 4**, 82 papers related to the subject area were considered relevant and therefore analysed in detail. The chart illustrates the distribution of publications per year. The first paper retrieved is the one from Brand and De Bruijn (1999), where the shared responsibility principles at the regional level are discussed, and the potential of building sustainable industrial estates. The work of Mirata (2004) and Mirata and Emtairah (2005) follows, studying the industrial symbiosis networks in the UK and Sweden. The following 9-year period reveals no interest in the study area, and not even a single contribution is recorded. In 2016 Banaite and Tamošiuniene are publishing the first academic contribution that uses the term 'circular economy' in the title. A sudden increasing trend in publishing papers starting from the year 2018 can be observed, which coincides with the publishing of the 2018 Circular Economy Package by the European Commission. The year 2019 has 17 recorded publications, which is the year when the European Commission adopted the Final

Circular Economy Package, and the growing trend continued in 2020 where the publication number peaked at 25. Considering the cut-off date for the data extraction was 13th May 2021, the 16 publications recorded in less than 5 months are a clear sign of growing academic interest in the field. This can be attributed to the commitment of the EU policy makers towards the policy design and implementation of the CE.

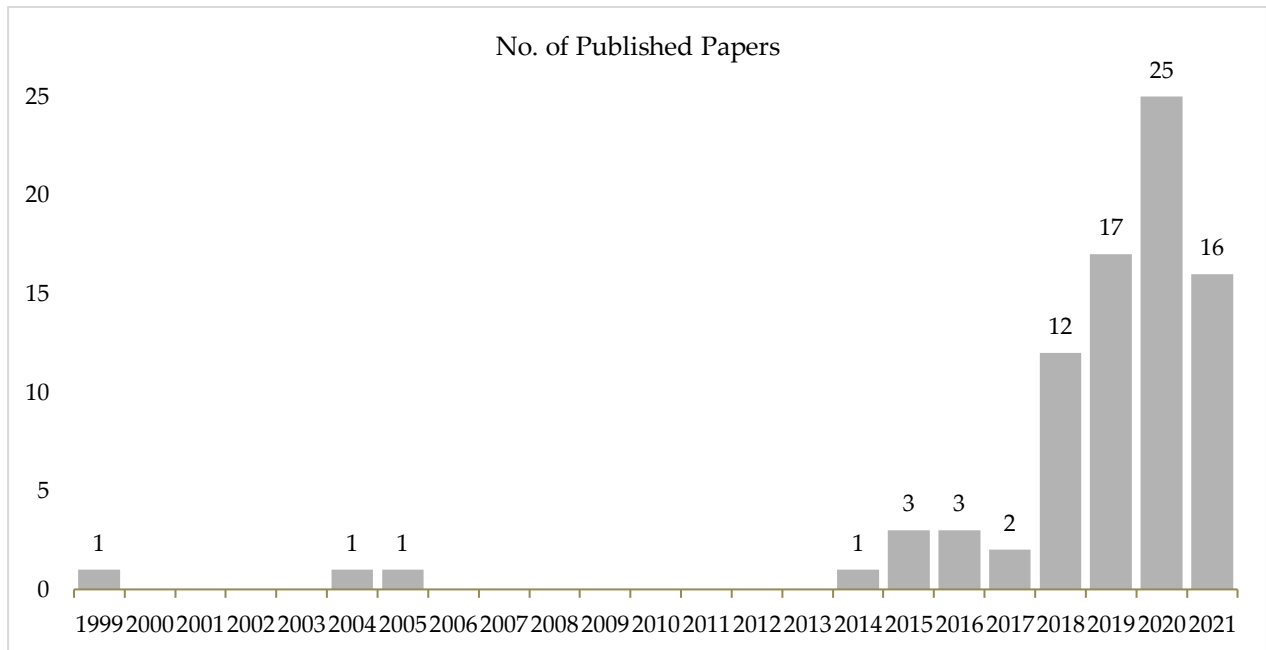


Figure 4: Historical series

2.3.2 Academic journals

The **Table 6** illustrates the top contributing journals which published the papers in the final data set. Overall, 57% of the papers were published in four journals. More than one-quarter of the papers were published in the Journal of Cleaner Production (22 papers). Sustainability (Switzerland) published 17 papers, followed by Waste Management and Environmental Engineering and Management Journal with 4 papers each. Another eight journals contributed with 2 papers each, while the remaining of the papers were published in 19 different journals. For the purpose to evaluate the scientific impact of the journals, the rankings provided by SCImago for the top contributing journals were considered. Most of them are in the Quartile 1 (Q1) group: Journal of Cleaner Production and Waste Management; Sustainability (Switzerland) is in the Q2, while in the Q3 is Environmental Engineering and Management Journal. What is interesting is that there is no representation of regional sciences journals (e.g.

Regional Studies, Journal of Regional Science, Annals of Regional Science, European Urban and Regional Studies). These findings will be complemented with the related findings from the bibliometric analysis (**section 2.4.5**) to get the overall view on this issue.

Journal	No. of Published Papers	% of Published Papers
Journal of Cleaner Production	22	27%
Sustainability (Switzerland)	17	21%
Waste Management	4	5%
Environmental Engineering and Management Journal	4	5%
Journal of Environmental Policy and Planning	2	2%
Sustainable Production and Consumption	2	2%
Economia Politica	2	2%
Urban Planning	2	2%
Journal of Industrial Ecology	2	2%
Economics and Policy of Energy and the Environment	2	2%
Resources, Conservation and Recycling	2	2%
Ecological Indicators	2	2%
Fashion Practice	1	1%
Natural Resources Research	1	1%
European Environment	1	1%
Journal of Security and Sustainability Issues	1	1%
Journal of Environmental Planning and Management	1	1%
Waste and Biomass Valorization	1	1%
European Planning Studies	1	1%
Science of the Total Environment	1	1%
Environmental Science and Pollution Research	1	1%
International Journal of Environmental Research and Public Health	1	1%
Environment and Planning C: Politics and Space	1	1%
Industrial Marketing Management	1	1%
Journal of Environment and Development	1	1%
FormAkademisk	1	1%
Ecological Economics	1	1%
Detritus	1	1%
Computers, Environment and Urban Systems	1	1%
Journal for Global Business Advancement	1	1%
International Journal of Sustainable Development and Planning	1	1%
Grand Total	82	100%

Table 6: Sources of the published papers

From the data in **Figure 5** it is apparent that the Journal of Cleaner Production has constantly been contributing to this topic, publishing works from the early 2000s. Regarding the continuity of publication, Sustainability (Switzerland) has also regular contributions. Generally, the diversity of journals publishing content in the topic has increased notably in the last three years, showing the increased interest from various leading journals in the field. These findings will be complemented with the related findings from the bibliometric analysis (**section 2.4.5**) to get the overall view on this issue.

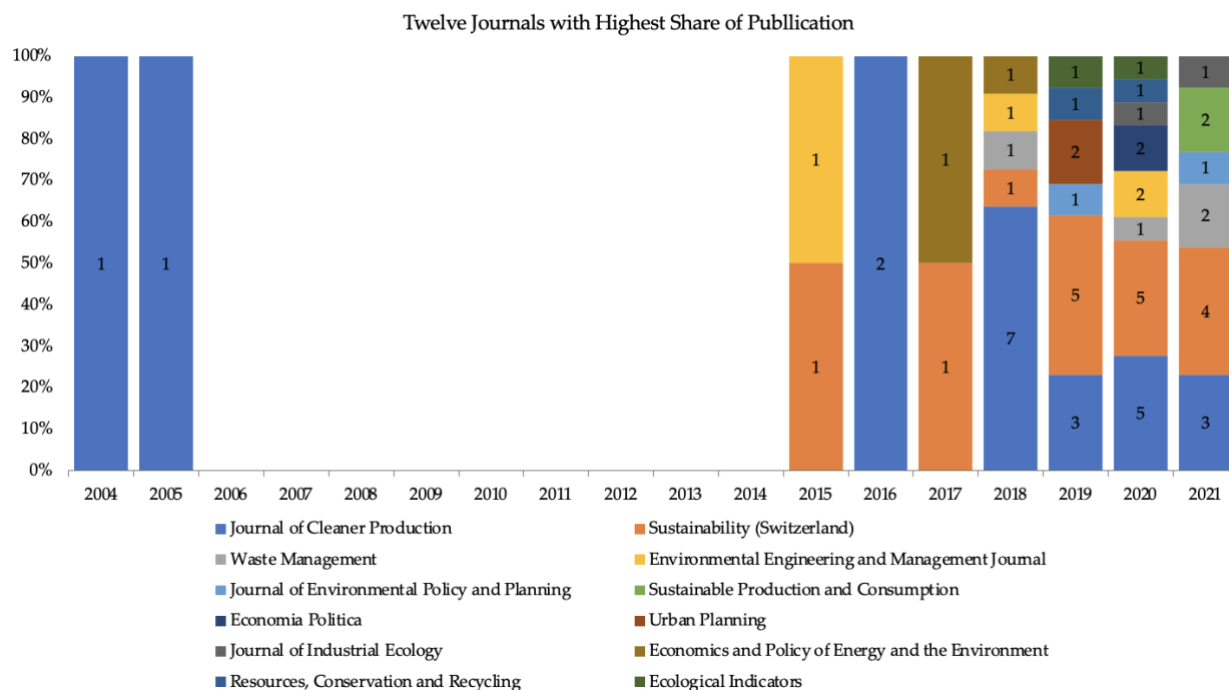


Figure 5: Twelve journals with highest share of publication

2.3.3 Geographical focus

The **Table 7** categorises the papers based on the country where the data was collected, or the related research context was stated. Ten papers reported multiple countries focus, but the individual countries were extracted, and the number was added per country. Seven papers reported data from larger number of EU regions (category: EU wide), and one paper except containing data from EU regions it had data from other global regions (category: Global). The top contributing countries are Italy (27 papers), The Netherlands (11 papers) and Spain (10 papers). There were five conceptual papers which did not have any specific geographic focus, hence the category 'no country'. The complete geographic map of the representative countries can be found in **Figure 6**. These findings will be complemented with the related findings from the bibliometric analysis (**section 2.4.2**) to get the overall view on this issue.

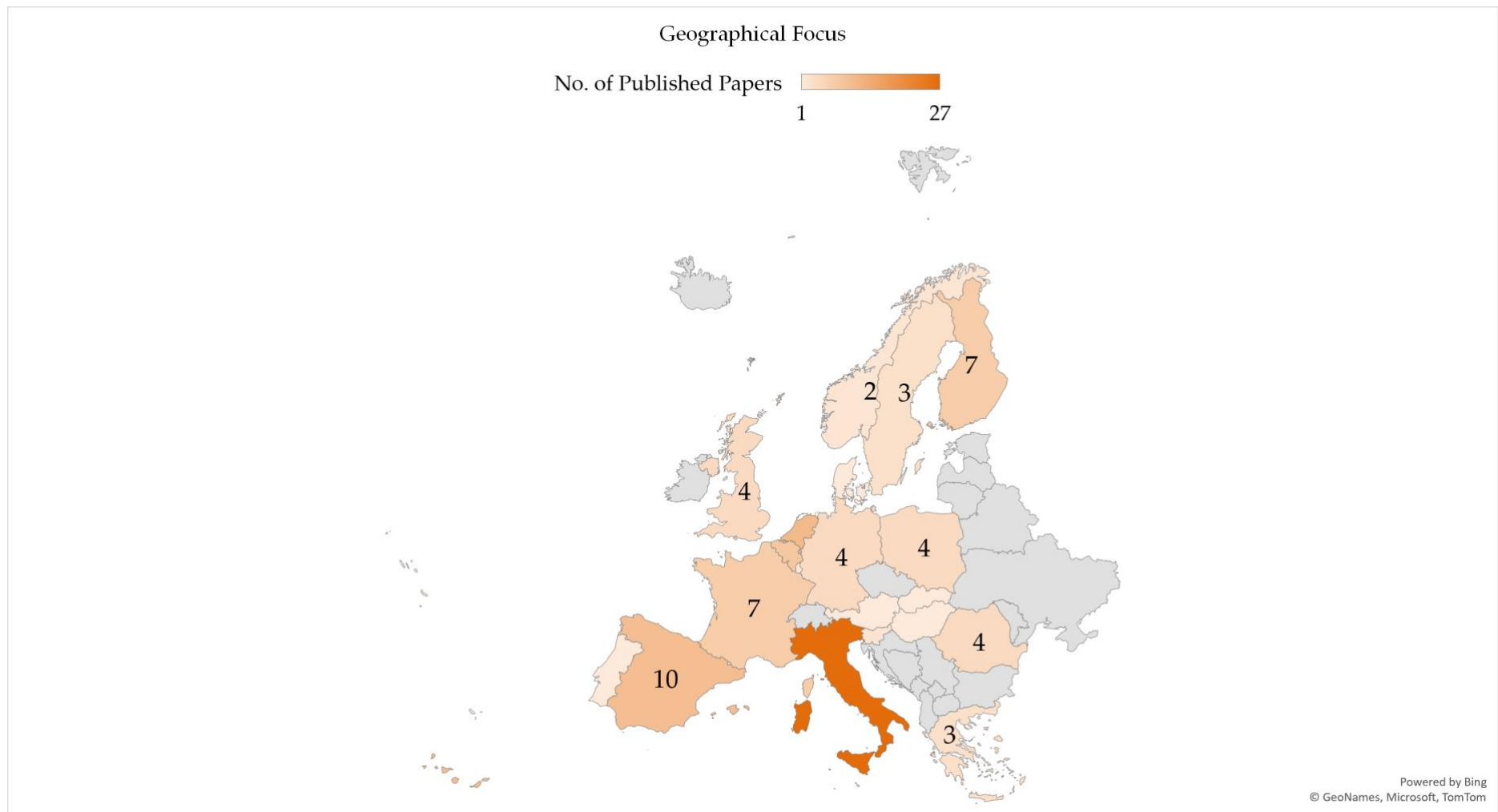


Figure 6: Geographical focus of the representative countries

Country	No. of Published Papers	Country	No. of Published Papers
Italy	27	Greece	3
The Netherlands	11	Sweden	3
Spain	10	Norway	2
Belgium	8	Slovenia	2
Finland	7	Austria	1
France	7	Denmark	1
EU wide	7	Hungary	1
No country	5	Luxembourg	1
Germany	4	Portugal	1
Poland	4	Slovakia	1
Romania	4	Global	1
United Kingdom	4		

Table 7: Papers classified by country of research

2.3.4 Research methodologies employed

Regarding the research methodologies employed in the papers, four categories were identified and presented in **Figure 7**. Half of the papers were from qualitative nature, deploying qualitative research methods for data collection and analysis. Quantitative research methodologies were used in 27% of the papers, and the use of mixed methods was reported in 17% of the papers. Around 6% of the papers were conceptual, not providing empirical data but rather discussing possible research focuses and conceptual frameworks.

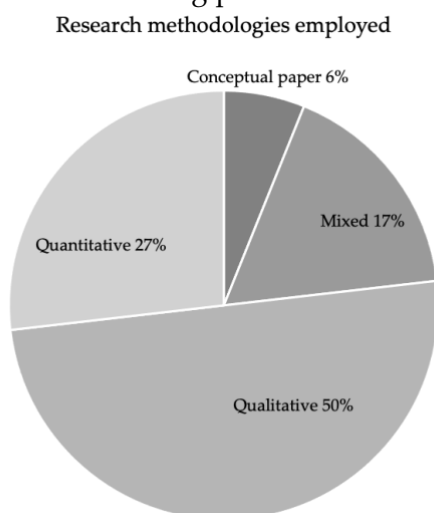


Figure 7: Employed research methodologies

2.4 Bibliometric findings

2.4.1 Subject/research areas

The subject areas (from Scopus) and research area (from WoS) were extracted to illustrate the top contributing areas. One paper can belong to several subject/research areas. It is evident that the Environmental Science/Ecology area has the leading position, with 71 papers belonging to it (**Figure 8**). The Energy area is following with 44 papers, Social Sciences with 28 and Engineering, Science Technology with 26 papers. Nevertheless, considering the topic in question, which is related to regional development and policy, tangent subject areas are not represented yet.

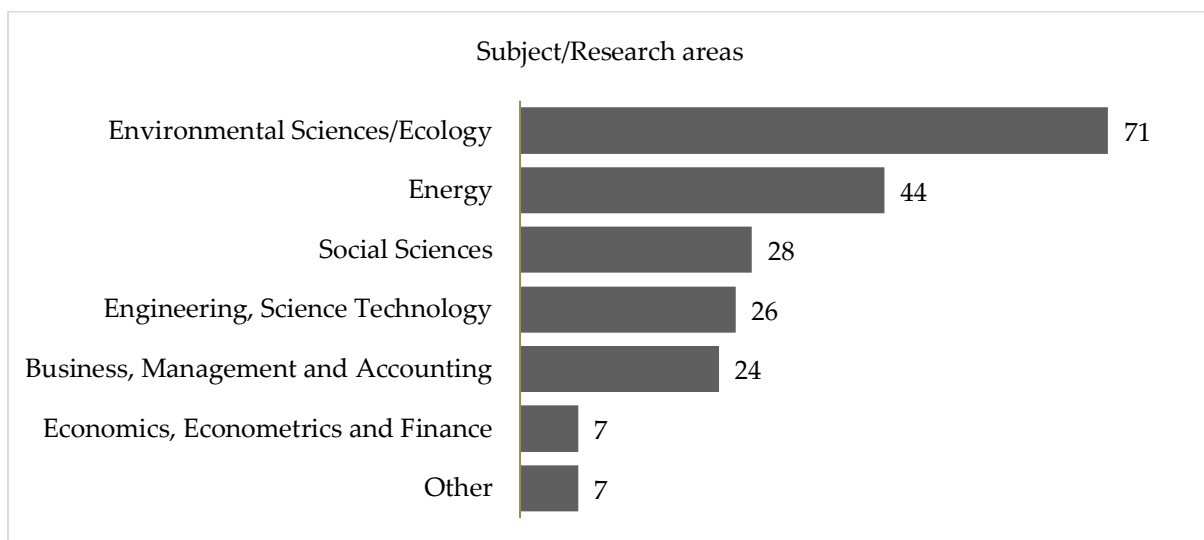


Figure 8: Subject/research areas of the published papers

2.4.2 Affiliation statistics, country of affiliation and funding sponsors

The data related to the authors affiliation was gathered from Scopus and WoS databases and analysed. In total there were 137 authors affiliations, which contributed to the 82 papers. The affiliations that contributed to more than two papers are presented in **Table 8**. The leading affiliation with 7 papers is Università degli Studi di Napoli Federico II (Italy), followed by Alma Mater Studiorum Università di Bologna (Italy) with 5 contributions. It is apparent that most authors' affiliations are located in Italy, followed by Belgium, the Netherlands, Germany, and Poland. Another 21 affiliations had published two papers, and 106 affiliations were associated to one paper only. This corresponds also to the results shown in **section 2.3.3**,

in **Table 7** and **Figure 6**, where the top three contributing countries where the research data was gathered or research context was stated, were again Italy, the Netherlands and Spain.

Affiliation	No. of papers	Country
Università degli Studi di Napoli Federico II	7	Italy
Alma Mater Studiorum Università di Bologna	5	Italy
Parthenope University Naples	4	Italy
Université Libre de Bruxelles	4	Belgium
Delft University of Technology	4	The Netherlands
Università degli Studi di Messina	4	Italy
University of G. d'Annunzio Chieti and Pescara	3	Italy
Technische Universität Darmstadt	3	Germany
AGH University of Science and Technology	3	Poland
Ente Per Le Nuove Tecnologie, l'Energia e l'Ambiente	3	Italy

Table 8: Top contributing affiliations

The countries of the authors' affiliations were obtained, processed further in Excel, and presented in **Table 9**. The leading country again is Italy, with 31 papers being written by authors belonging to an Italian affiliation. The Netherlands is following with 11 papers and Spain with 8 papers. This is in line with the results presented in **section 2.3.3** and **Table 7**.

Country of Affiliation	No. of Papers	Country of Affiliation	No. of Papers
Italy	31	Norway	2
Netherlands	11	United States	2
Spain	8	Undefined	2
Germany	7	Australia	1
Finland	7	Austria	1
Belgium	6	Brazil	1
Sweden	6	China	1
Poland	5	Cyprus	1
France	4	Czech Republic	1
Greece	4	Lithuania	1
United Kingdom	4	Malaysia	1
Denmark	3	Romania	1
Hungary	2	Slovakia	1

Table 9: Countries of affiliations

The information regarding the funding sponsors was also extracted and analysed. What is worth noting is that 49% of the research was funded by the EU, through the European Commission, Horizon 2020 programmes, Cohesion fund, European Regional Development Fund, European Social Fund, European Agricultural Fund for Rural Development, Interreg program and similar fund and programmes. The remaining of the papers were funded by educational institutions, government and governmental agencies, regional councils. Some research was having more than one funding sponsor. This clearly shows the role of the EU in supporting the research in this area.

2.4.3 Keywords co-occurrence analysis

The author keywords from both Scopus and WoS were retrieved, in CSV and Plain Text files respectively, and analysed using the VOSviewer software. In total the 82 papers reported 306 author keywords. The co-occurrence of the author keywords was mapped visually, initially using all 306 keywords and minimum number of 1 occurrence of a keyword.

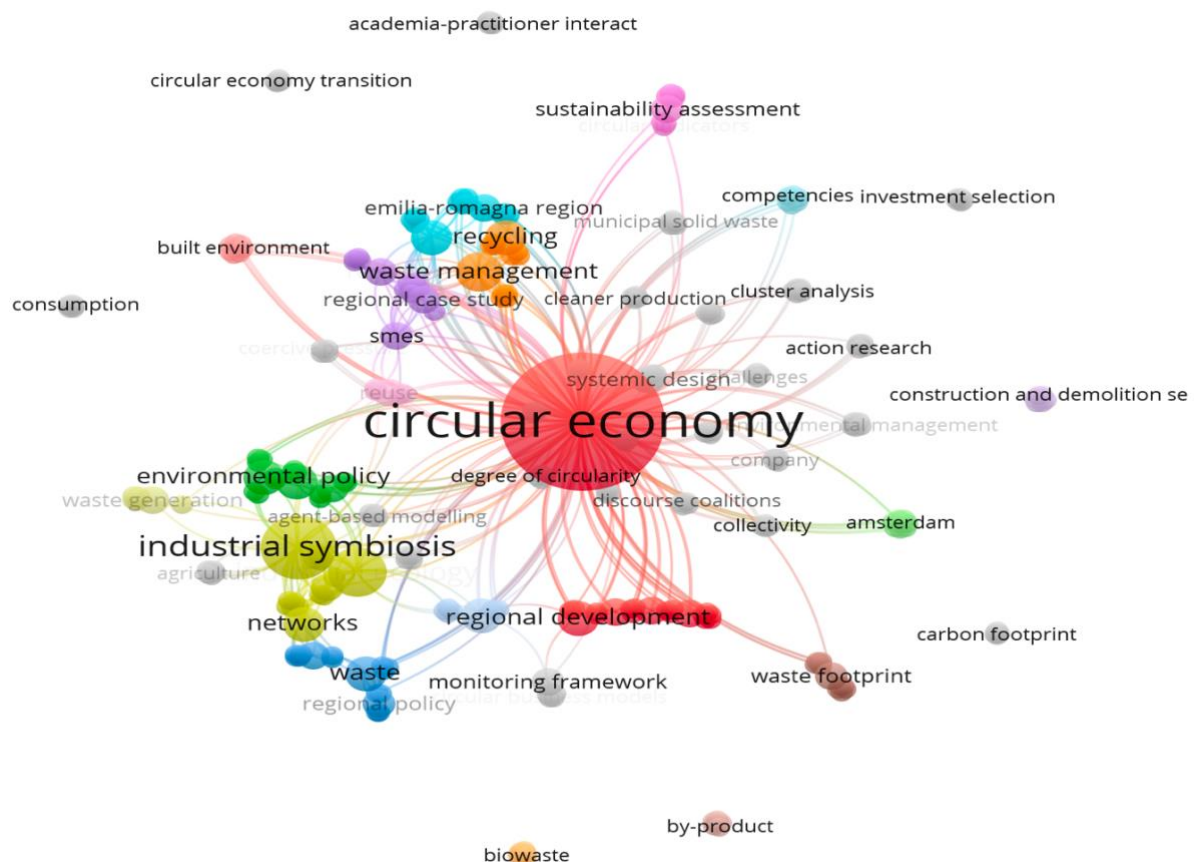


Figure 9: The network visualisation of keywords (minimum keyword occurrence - 1)

In the bibliometric analysis, VOSviewer can display 3 different mapping visualisations, namely **Figure 9** (network visualisation), **Figure 10** (overlay visualisation), and **Figure 11** (density visualisation). After being analysed by the VOSviewer software, 45 clusters have been obtained in the mapping of all keywords, showing there was a relationship between one keyword to another. The thickness of the connecting line showed the strength of pairs of keywords. Apart from clusters and lines, the size of the nodes indicated the frequency with which the keyword appears. From **Figure 9**, the dominant keyword by far is ‘circular economy’, followed by ‘industrial symbiosis’, ‘environmental policy’, ‘regional development’ and ‘waste management’. This implies that these topics in the 1999-2021 period were the most discussed by researchers. Nodes or keywords that did not have a network with other keywords, have the potential to become new research topics in the future.

Figure 10 shows the year-to-year trends related to the keyword being used. The colours in the keywords indicate the period of research. As reported in **section 2.3.1** the earliest reported research is related to ‘industrial symbiosis’, ‘network’, ‘by-product’ and ‘environmental policy’ (purple cluster), and the latest research reports keywords like ‘circular economy transition’, degree of circularity’, ‘waste footprint’, Emilia-Romagna region’.

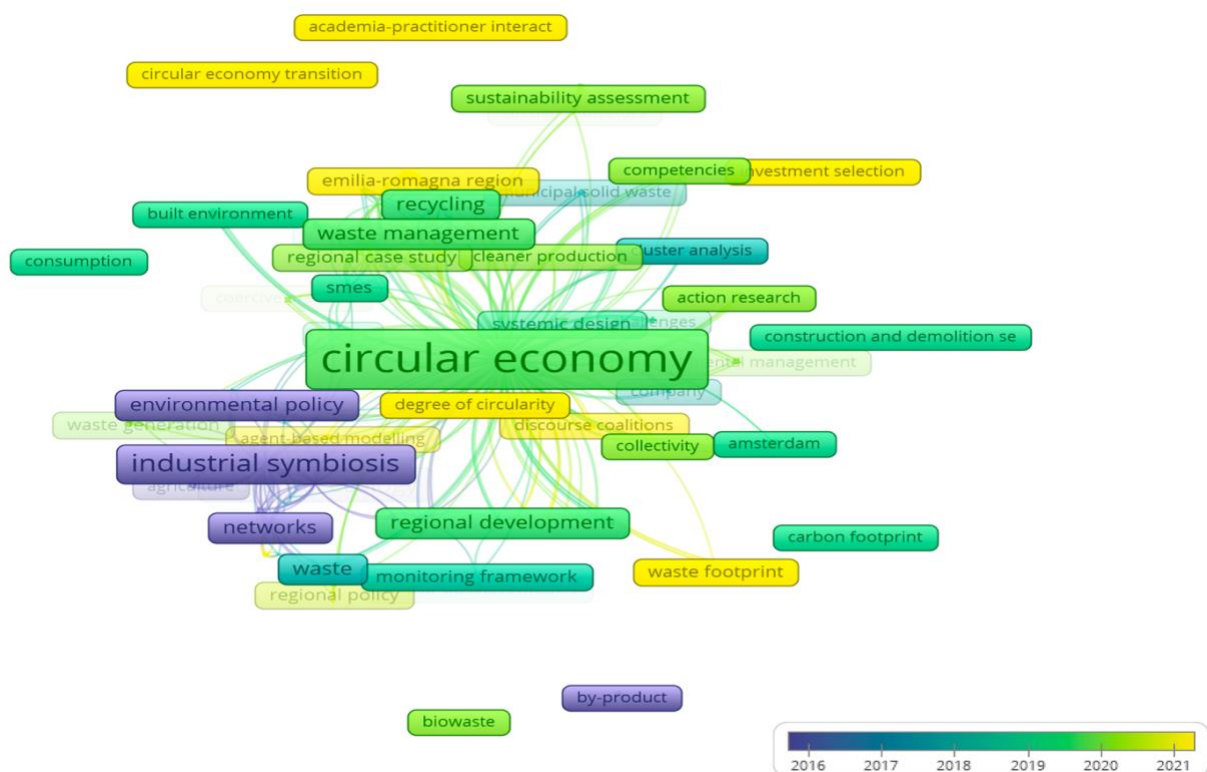


Figure 10: The overlay visualisation of keywords (minimum keyword occurrence - 1)

The depth of research related to the keyword can be seen in **Figure 11**. The more concentrated the colours, the more researchers are conducting research related to the keyword. 'Circular economy', 'industrial symbiosis', 'recycling', 'environmental policy' are topics that are widely discussed.

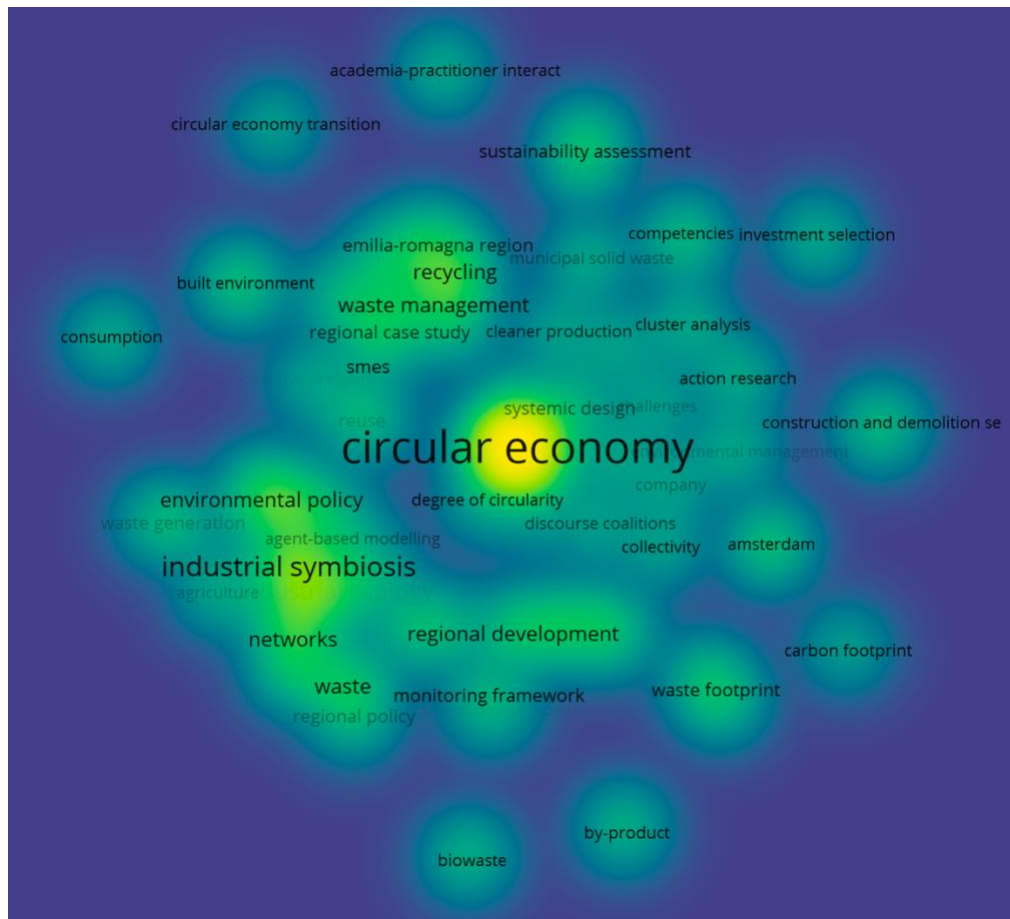


Figure 11: The density visualisation of keywords (minimum keyword occurrence - 1)

In order to focus on the most frequently used keywords and their relationship, the whole procedure was repeated, this time focusing on keywords which were encountered at least 3 times in the final data set. Only 12 keywords met the threshold, and they are presented in **Figure 12** (network visualisation), **Figure 13** (overlay visualisation) and **Figure 14** (density visualisation). The network visualisation (**Figure 12**) created four clusters of keywords, red cluster ('networks', 'industrial ecology', 'industrial symbiosis', 'environmental sustainability' and 'environmental policy'), green cluster ('circular economy', 'sustainability', 'waste management' and 'recycling'), blue cluster ('sustainable development' and 'regional development') and yellow cluster ('waste').

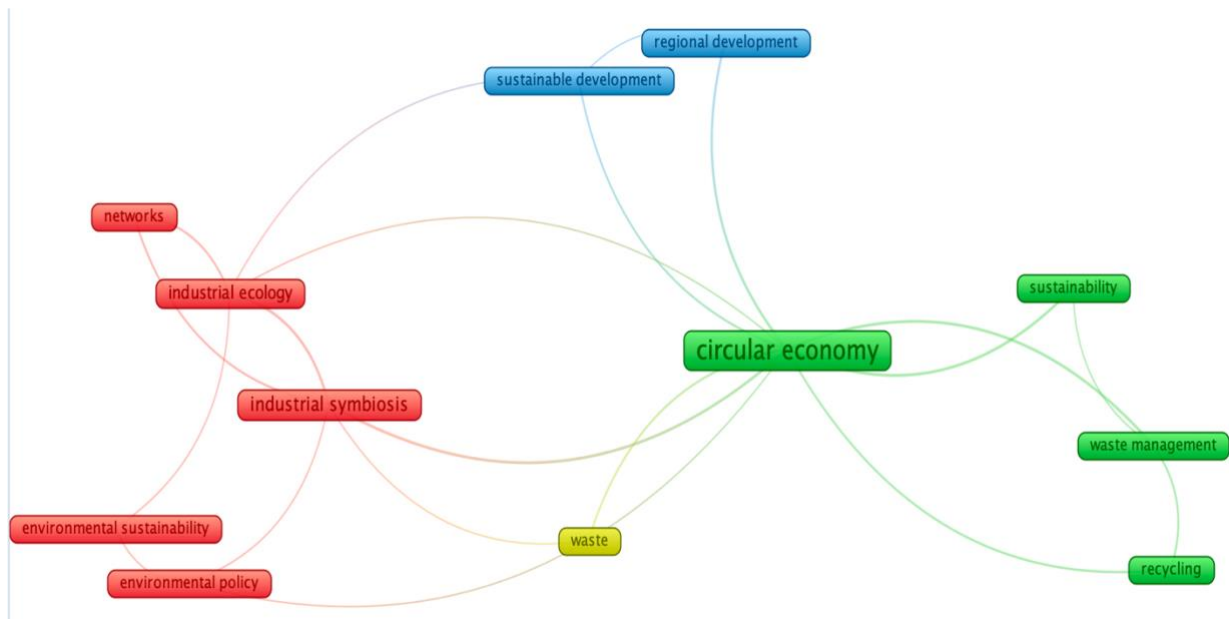


Figure 12: The network visualisation of keywords (minimum keyword occurrence - 3)

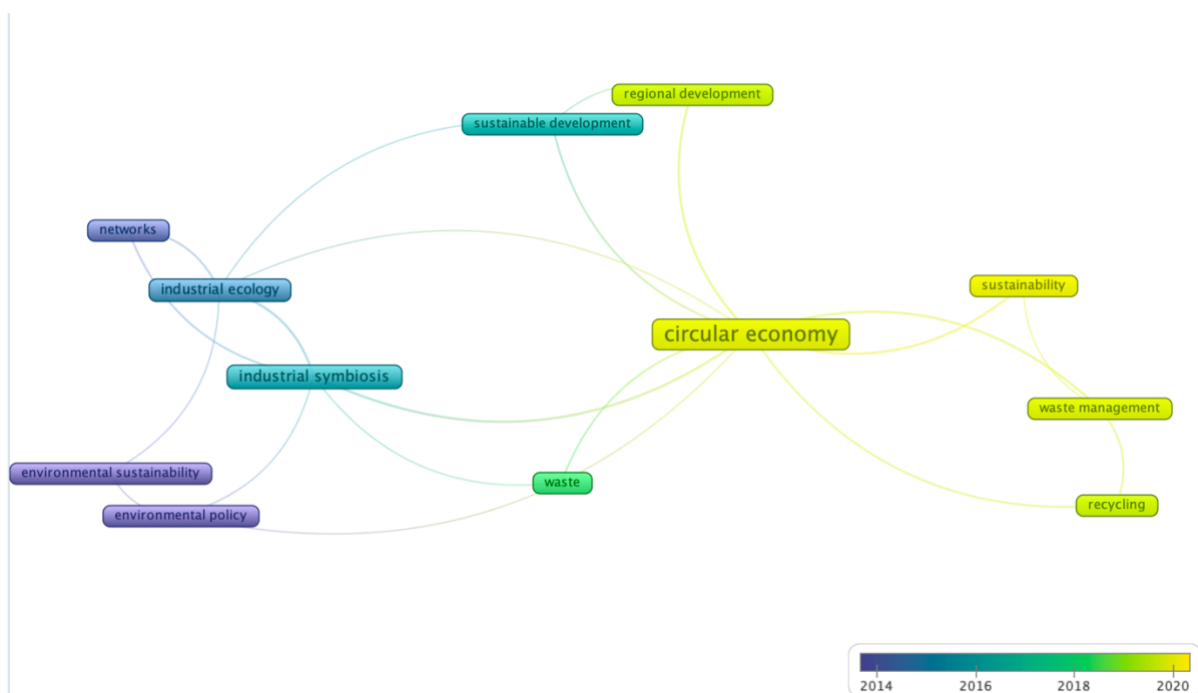


Figure 13: The overlay visualisation of keywords (minimum keyword occurrence - 3)

The overlay visualisation (**Figure 13**) shows the distribution of keywords in the period under examination, revealing keywords such as “regional development”, ‘recycling’, ‘waste management’, ‘sustainability’ and ‘circular economy’ appeared in the period of the last two years.

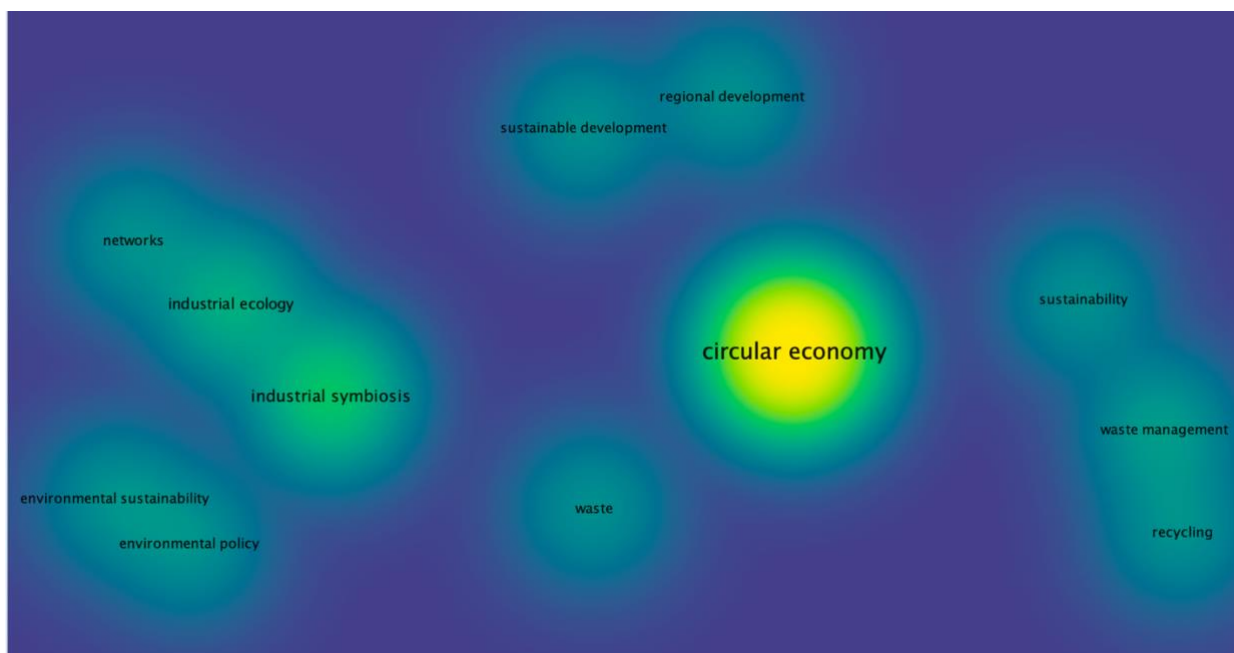


Figure 14: The density visualisation of keywords (minimum keyword occurrence - 3)

The density visualisation (**Figure 14**) shows the depth of research related to the keywords. When restricted to minimum three occurrences of keyword, the results show the word 'circular economy' was by far the most encountered one.

The co-occurrence analysis is using the authors keywords to explore the conceptual structure in a research field. This technic, by constructing a measure of similarity, is one of the most effective ways to cultivate trends and emergent topics in a scientific field, as well as paving the avenue for future research (Fabregat-Aibar et al., 2019).

2.4.4 Authors, co-authorship, and citation of authors analysis

The extracted data from the 82 articles was analysed and the frequency of publishing by author was observed. As shown in **Table 10**, out of 228 authors, in total eight authors have published more than two papers, Ioppolo being the one with the highest number of published papers (4 in total). Seven authors have published three articles, 28 authors have contributed to two papers and the rest 147 authors contributed to only one article from the dataset. Additionally, the h-index for the top eight contributing authors was obtained from Scopus, expressed as the number of papers with citation number higher or equal than the number of

published papers, as a valuable measurement to describe the scientific productivity of a researcher (Hirsch, 2005). The highest h-index had Ioppolo (23), followed by Achten (22), and Bonoli (13). According to Hirsch (2005), the proponent of the h-index, an author with an h-index of 60 after 20 years of scientific activity is considered as truly unique individual, and h-index of 40 characterises outstanding scientists and h-index of 20 successful scientists.

Author	No. of Papers	h-index
Ioppolo G.	4	23
Arbolino R.	3	8
Bonoli A.	3	13
Manskinen K.	3	7
Achten W. M. J.	3	22
Towa E.	3	9
Zeller V.	3	4
Avdiushchenko A.	3	5

Table 10: Authors contribution and influence

In order to analyse the co-authorship links, the number of publications two researchers have co-authored, a co-authorship analysis was performed using the VOSviewer software. Considering that it is a new research field, and the majority of scientific contributions were published in the last two years, the minimum number of documents of an author was chosen to be one, hence the inclusion of all authors, and there was no limitation in terms of minimum number of citations of an author. The network visualisation, presented in **Figure 15**, revealed a scattered picture with 52 clusters, implying that individual authors are exploring the topic and very few links between the 228 authors exist in terms of co-authorship. This could be explained by the novelty of the research topic and the infancy stage it is currently. Authors Ioppolo, Bonoli, Dabrowski, Amenta, Moussiopoulos and Avdiushchenko are the leading authors who have produced the highest number of papers in collaboration. **Figure 16** is illustrating the co-authorship in terms of the time frame they published their work, the purple clusters denoting the earliest collaborations and the yellow ones the latest. Finally, the density visualisation in **Figure 17** shows the depth of the co-authorship.

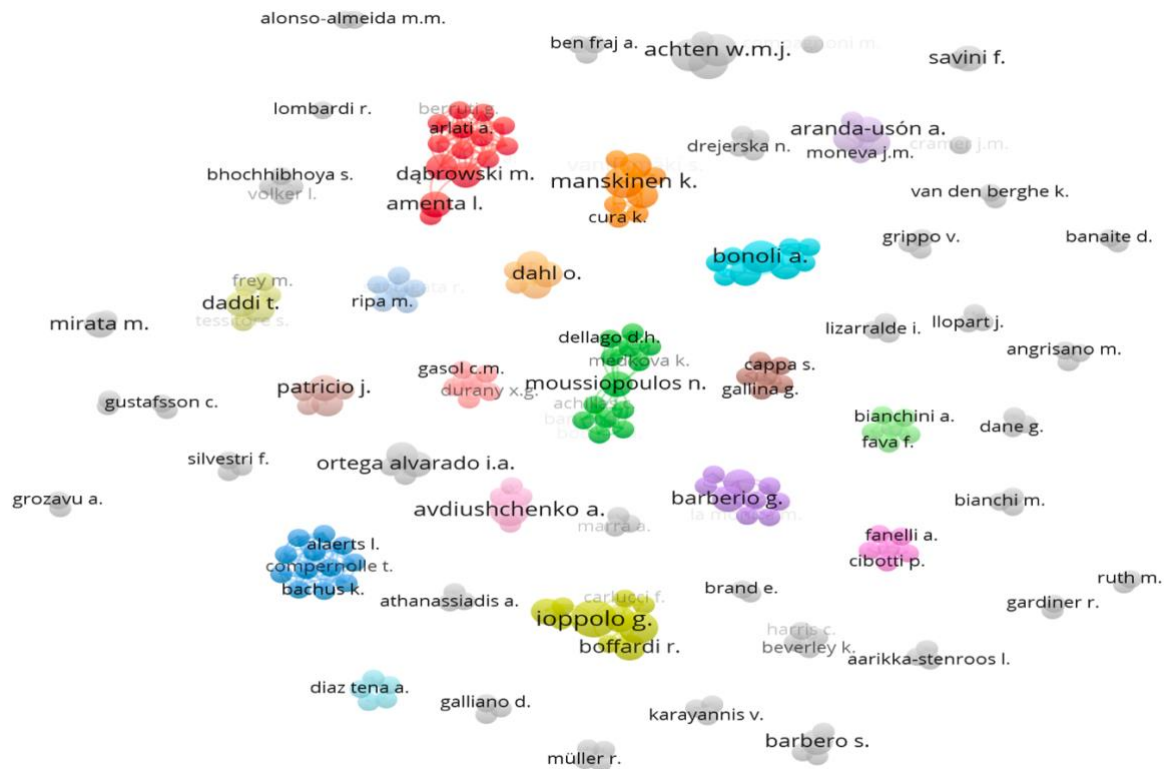


Figure 16: The network visualisation of co-authorship (minimum number of documents of an author - 1)

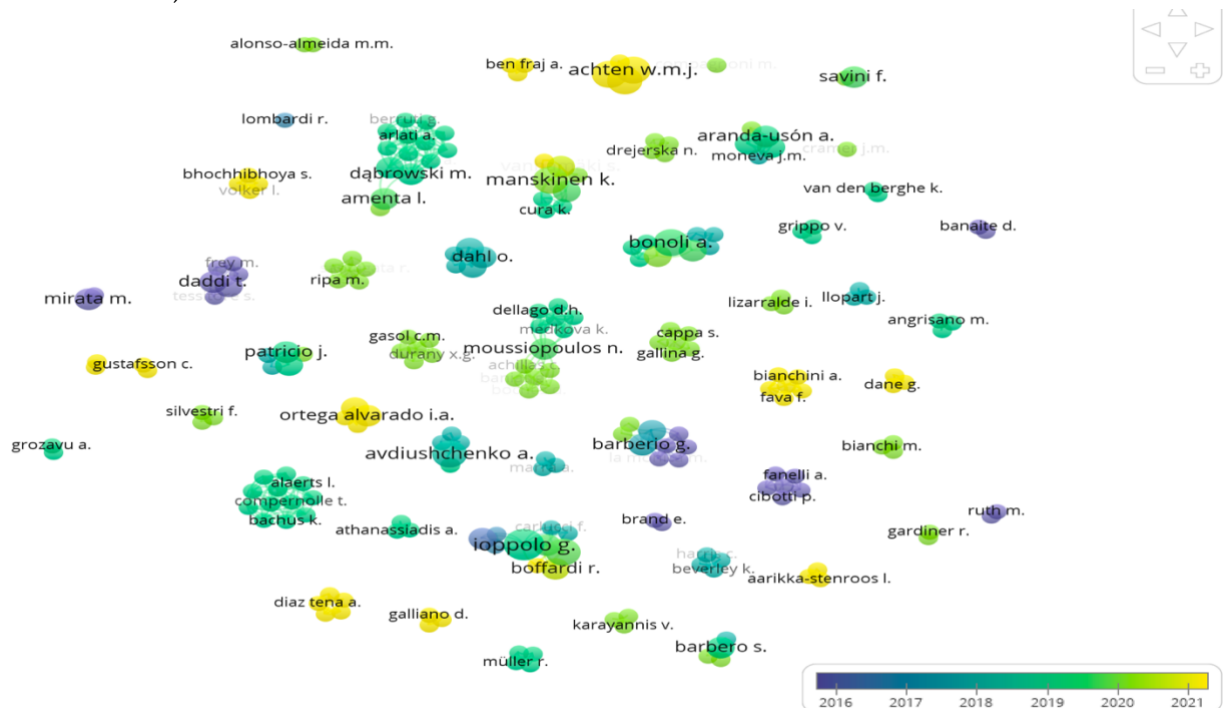


Figure 15: The overlay visualisation of co-authorship (minimum number of documents of an author - 1)

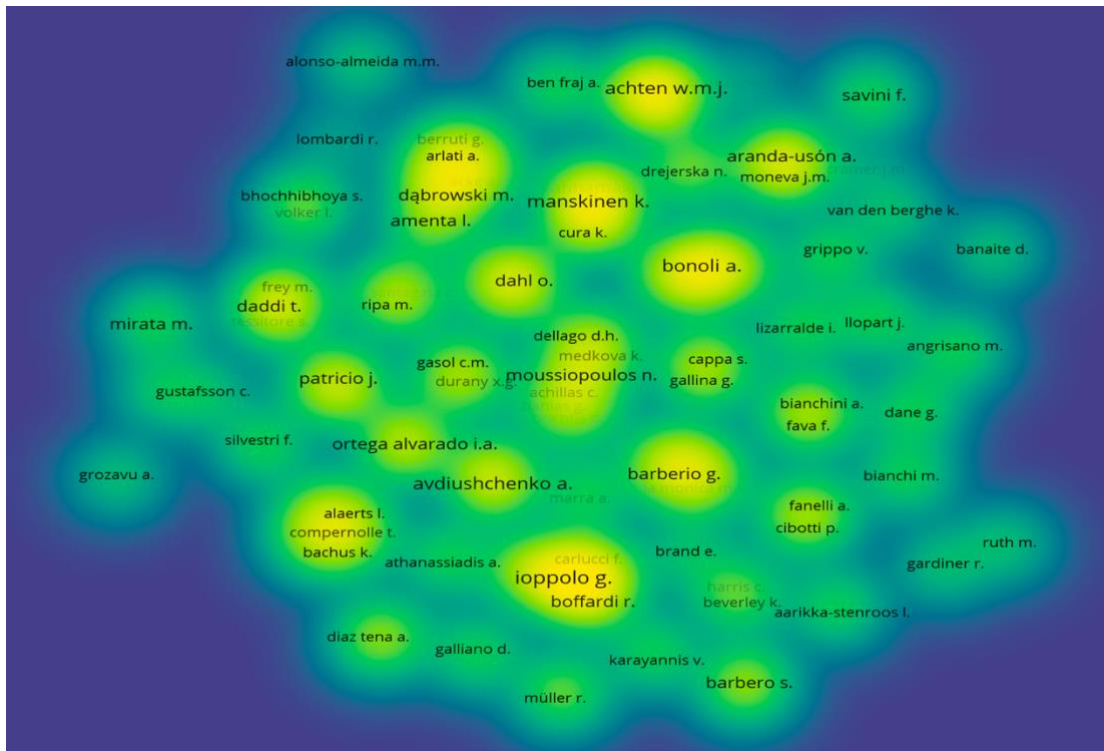


Figure 17: The density visualisation of co-authorship (minimum number of documents of an author - 1)

Considering the individualistic approach to research, as already shown in **Figure 15**, many of the authors were not connected, and their link was very weak. In order to “zoom in” in the largest set of connected authors, **Figure 18** was created, displaying 14 authors in two clusters, based on their links and collaboration activities.

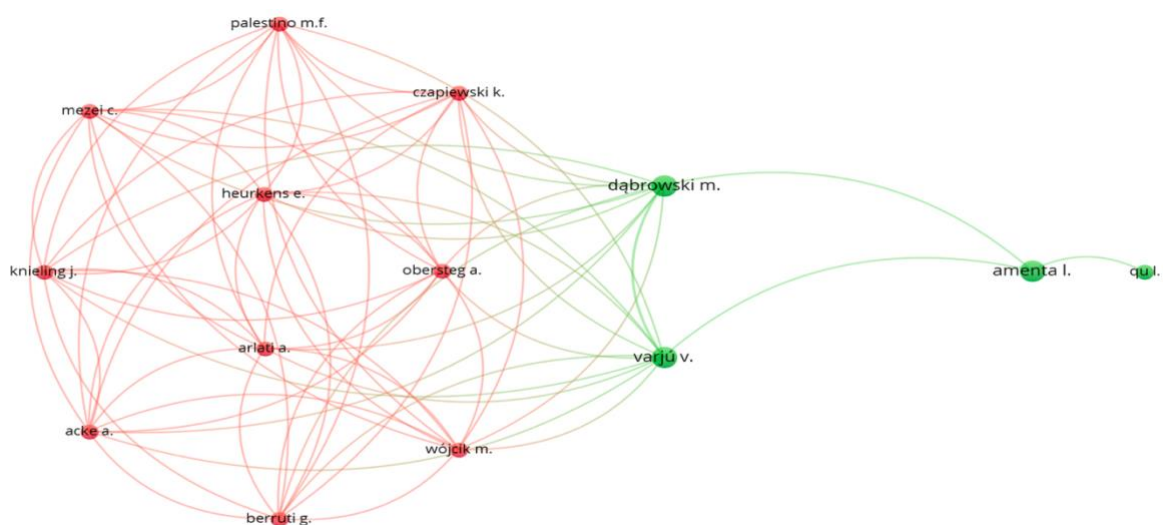


Figure 18: The network visualisation of co-authorship (minimum number of documents of an author - 1, largest set of connected items)

With the purpose to complement the analysis, a further investigation was performed to map the citation links between authors. Again, the minimum number of documents of an author was chosen to be one, hence the inclusion of all 228 authors, and there was no limitation in terms of minimum number of citations of an author. The network visualisation presented in **Figure 19** showed a scattered picture with 151 clusters, implying the authors in the dataset did not cite each other. Only 11 clusters were comprised of more than one author, the remaining 140 clusters were comprised of one author. These 11 clusters including 35 authors with the strongest links in terms of citations between them are depicted in **Figure 20**. Taking into regard that 50% of the papers were published from 1st January 2020 until 13th May 2021, and the information regarding the number of citations was extracted on 13th June 2021, the results are somewhat expected since all contributions are relatively novel, and the research area is in infancy stage.

Figure 19: The network visualisation of authors citation (minimum number of documents of an author – 1)



Figure 20: The network visualisation of authors citation (minimum number of documents of an author – 1, largest set of connected items)

In terms of the density visualisation, **Figure 21** is depicting the citation links between authors, the yellow colour suggesting the deepest links among authors in terms of citations, and the blue colour suggestion a rather looser links among authors.



Figure 21: The density visualisation of authors citations (minimum number of documents of an author - 1)

2.4.5 Sources citation analysis

Citation analysis of sources was performed using the VOSviewer, with the goal to visually map the citation links among the 29 sources, i.e. journals. The minimum number of documents of a source was selected to be 1, for the reasons already explained in **section 2.4.3** and **2.4.4**, and no limit in terms of minimum citations was chosen. The network visualisation, illustrated in **Figure 22**, showed very loose citation links among sources, similarly with the results from the authors citation analysis in **section 2.4.4**. The 29 sources were categorised into 22 clusters, with only 3 clusters containing more than 1 source (10 sources in total), and the remaining 19 papers were comprising a stand-alone cluster by its own. These fragmented results are suggesting that only a few journals within the dataset are being cited by the rest of the journals in the same dataset, which again can be rationalised by the novelty of the field.

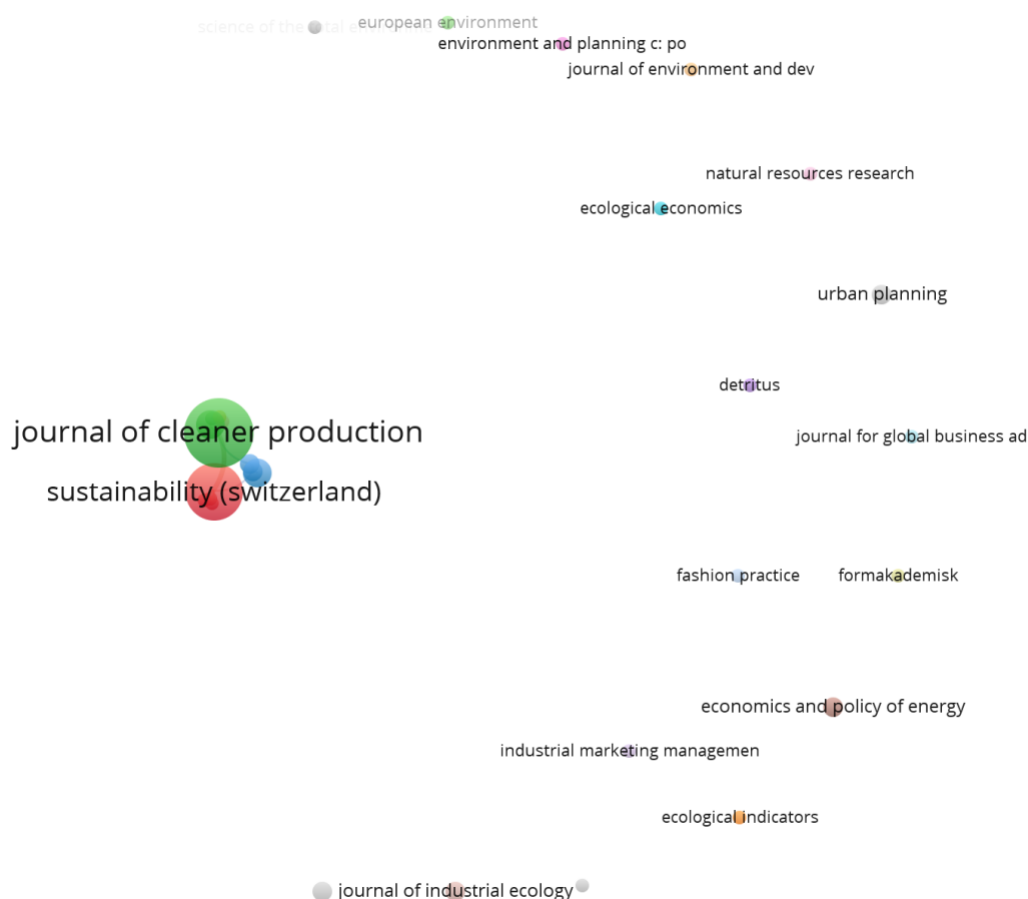


Figure 22: The network visualisation of sources citation (minimum number of documents of a source – 1)

It is obvious that Journal of Cleaner Production and Sustainability (Switzerland) are the most dominant sources with the highest citation links, which corresponds to the findings from **section 2.3.2**. **Figure 23** is showing the largest set of connected items, in this case 12, of journals that have reported the highest citations in the dataset. Five clusters were identified - red (European Planning Studies, International Journal of Environmental Research and Public Health, International Journal of Sustainable Development and Planning, Sustainability (Switzerland)), green (Computers, Environment and Urban Systems, Environmental Science and Pollution Research, Journal of Cleaner Production), blue (Journal of Environmental Policy and Planning, Sustainable Production and Consumption, Waste Management), yellow (Environmental Engineering and Management journal) and purple (Journal of Security and Sustainability Issues). The results from the density visualisation in **Figure 24** are clearly supporting the dominance of Journal of Cleaner Production and Sustainability (Switzerland) in terms of the deepest links of source citation among the data set.

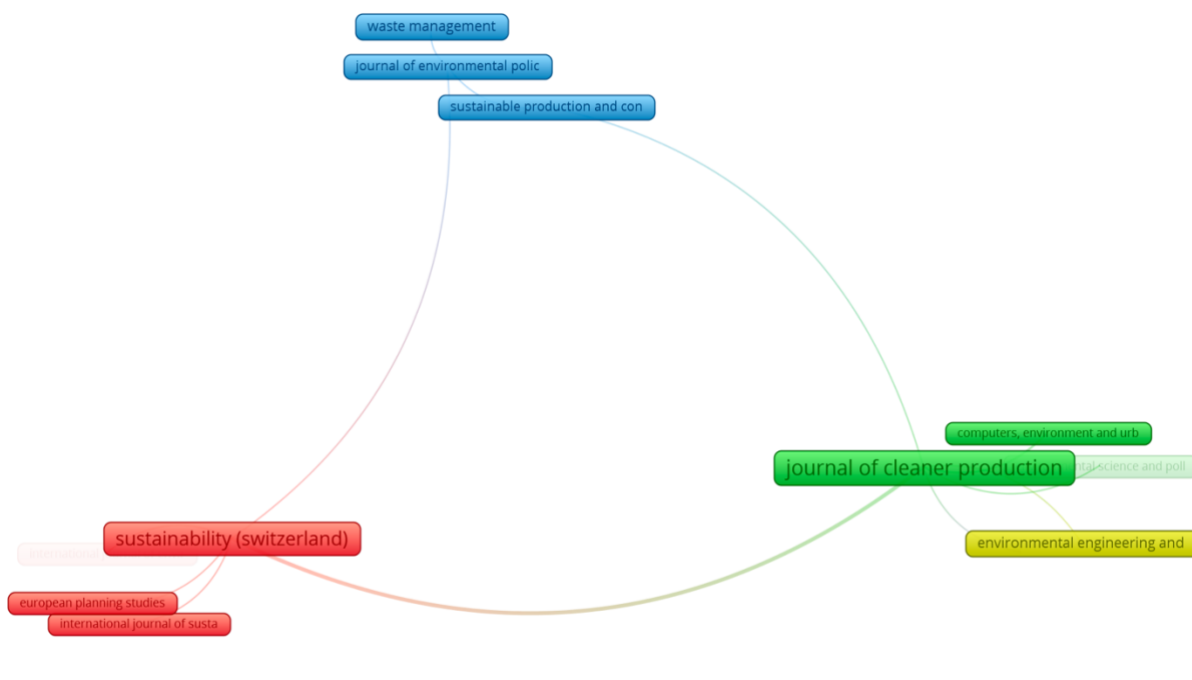


Figure 23: The network visualisation of sources citation (minimum number of documents of a source – 1, largest set of connected items)

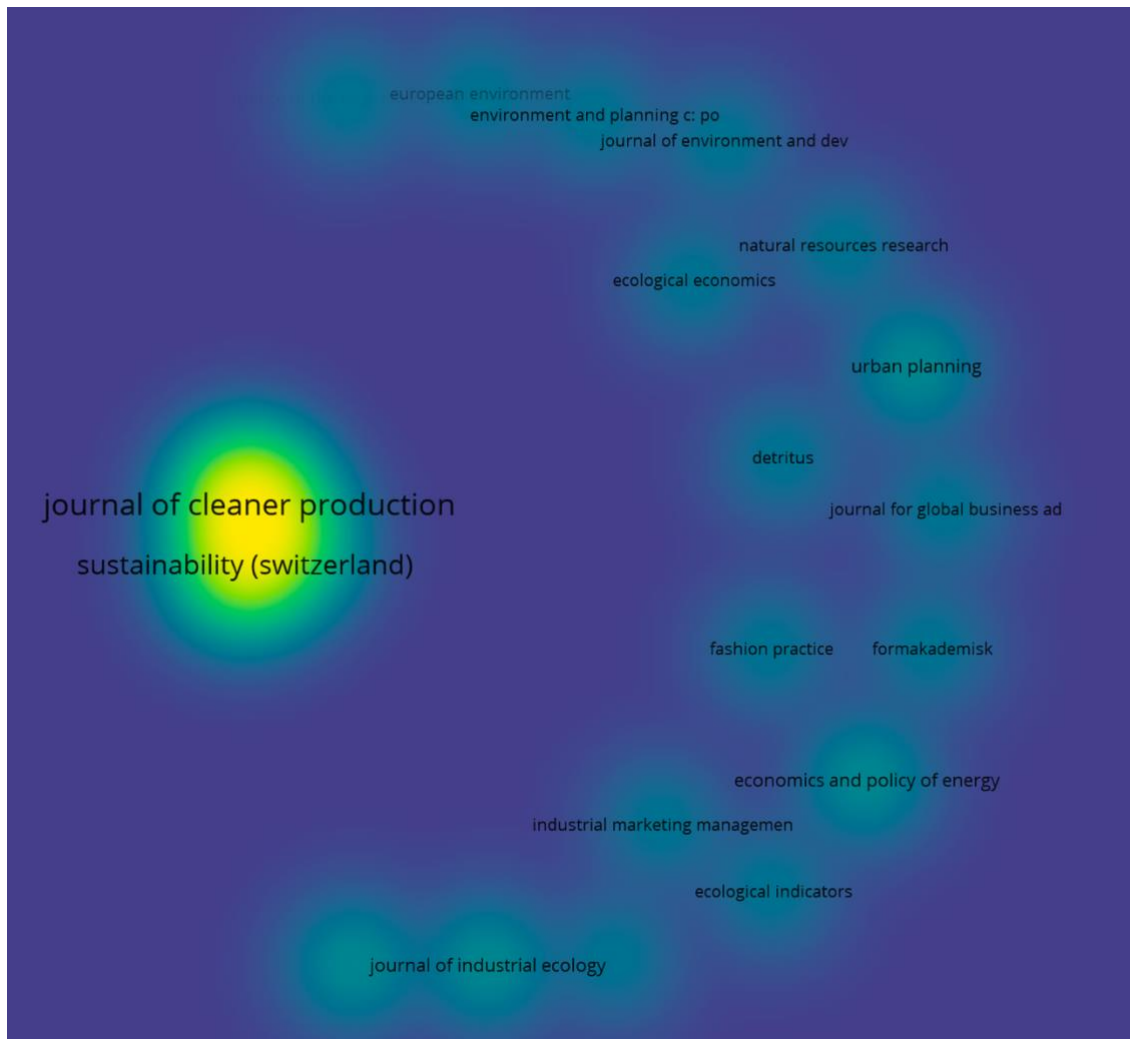


Figure 24: The density visualisation of sources citations (minimum number of documents of a source - 1)

An attempt to capture the co-citation links among sources was made, including in the analysis the reference lists of the 82 papers in the final data set. However, the Scopus data on cited sources has not been harmonized, and the source names didn't have a consistent format, leading to double or more counting the same journal in the map (e.g. showing it as Journal of Cleaner Production, J. Clean. Prod., J. Clean. Prod, J. Cleaner Prod.). Therefore, a decision to not perform this analysis was made.

2.4.6 Citations statistics

To identify the most cited papers the relevant data was extracted from the two databases and sorted accordingly in Excel. The extraction was made on 12th June 2021, hence the citations per paper were considered until then. The top ten cited papers are shown in **Table 11**.

	Title	Authors	Source	Year of Publication	Total Citations
1.	Experiences from early stages of a national industrial symbiosis programme in the UK: Determinants and coordination challenges	Mirata M.	Journal of Cleaner Production	2004	219
2.	Industrial symbiosis networks and the contribution to environmental innovation: The case of the Lindstrom industrial symbiosis programme	Mirata M., Emtairah T.	Journal of Cleaner Production	2005	187
3.	Towards a sustainable industrial ecology: Implementation of a novel approach in the performance evaluation of Italian regions	Arbolino R., De Simone L., Carlucci F., Yigitcanlar T., Ioppolo G.	Journal of Cleaner Production	2018	58
4.	Shared responsibility at the regional level: The building of sustainable industrial estates	Brand E., De Bruijn T.	European Environment	1999	39
5.	Industrial symbiosis, networking, and innovation: The potential role of innovation poles	Taddeo R., Simboli A., Ioppolo G., Morgante A.	Sustainability (Switzerland)	2017	37
6.	Circular economy strategies in eight historic port cities: Criteria and indicators towards a circular city assessment framework	Gravagnuolo A., Angrisano M., Girard L.F.	Sustainability (Switzerland)	2019	33
7.	Barriers and challenges to plastics valorisation in the context of a circular economy: Case studies from Italy	Paletta A., Leal Filho W., Balogun A.-L., Foschi E., Bonoli A.	Journal of Cleaner Production	2019	27
8.	Forest sector circular economy development in Finland: A regional study on sustainability driven competitive advantage and an assessment of the potential for cascading recovered solid wood	Husgafvel R., Linkosalmi L., Hughes M., Kanerva J., Dahl O.	Journal of Cleaner Production	2018	25
9.	The development of regional collaboration for resource efficiency: A network perspective on industrial symbiosis	Zhu J., Ruth M.	Computers, Environment and Urban Systems	2014	
10.	The experience of the first industrial symbiosis platform in Italy	Cutaia L., Luciano A., Barberio G., Sbaffoni S., Mancuso E., Scagliarino C., La Monica M.	Environmental Engineering and Management Journal	2015	24

Table 11: Top 10 cited paper

The leading three articles were published in Journal of Cleaner Production with 219, 187 and 58 citations respectively. Overall, five of the ten most cited paper were published in Journal of Cleaner Production, followed by Sustainability (Switzerland) with 2 papers. To understand the impact factor of the final dataset of 82 articles, the average number of citations per paper was calculated. The total number of citations for all 82 articles was 1,170 which resulted in the average number of citations per paper to be 14,27.

In order to better understand whether there is a concentration of research outputs in only several publishing sources, a further analysis of the top three cited papers was performed and presented. Namely, the most cited paper with 219 citations by Mirata (2004), published in Journal of Cleaner Production, was analysed in more details. As shown in **Table 12**, 32% of the papers which cited this paper (70 citations in total) were also published by Journal of Cleaner Production, followed by Journal of Industrial Ecology (8%) and Sustainability (Switzerland) (7%).

Source	Count	Percentage
Journal of Cleaner Production	70	32%
Journal of Industrial Ecology	18	8%
Sustainability (Switzerland)	16	7%
Resources, Conservation and Recycling	10	5%
Progress in Industrial Ecology	7	3%
Subtotal	121	55%
Other Sources	98	45%
Total	219	100%

Table 12: Publishing sources of papers which cited Mirata (2004)

The second most cited paper with 187 citations by Mirata and Emtairah (2005), published in Journal of Cleaner Production, was analysed as well. As shown in **Table 13**, 27% of the papers which cited this paper (51 citations in total) were also published by Journal of Cleaner Production, followed by Sustainability (Switzerland) (6%) and Journal of Industrial Ecology (6%).

The third most cited paper, with 58 citations by Arbolino et al., (2018) published in Journal of Cleaner Production also went through the same analysis. Results (**Table 14**) showed that 21% of the papers which cited this paper were also published in Journal of Cleaner Production and equally 21% of them were published by Sustainability (Switzerland).

Source	Count	Percentage
Journal of Cleaner Production	51	27%
Sustainability (Switzerland)	12	6%
Journal of Industrial Ecology	11	6%
Shengtai Xuebao Acta Ecologica Sinica	5	3%
Progress in Industrial Ecology	4	2%
Subtotal	83	44%
Other Sources	104	56%
Total	187	100%

Table 14: Publishing sources of papers which cited Mirata and Emtairah (2005)

Source	Count	Percentage
Journal of Cleaner Production	12	21%
Sustainability (Switzerland)	12	21%
Land Use Policy	7	12%
Subtotal	31	53%
Other Sources	27	47%
Total	58	100%

Table 13: Publishing sources of papers which cited Arbolino et al. (2018)

These results, complemented with the ones from **section 2.3.2** which showed that 48% of the papers were published in the two journals – Journal of Cleaner Production and Sustainability (Switzerland), prove that a considerable amount of the research output in the field is being concentrated in these publishing sources. Moreover, a self-referencing phenomenon can be observed, which could imply that the impact of the research outputs is only on the tangent disciplines. However, Marra et al. (2018) reckon that a factual implementation of CE can be safeguarded only by multidisciplinary approaches. The outcome of their work complements the above-mentioned results. More precisely, in a quest to assess the level of multidisciplinary of the CE literature, they show that multidisciplinary in the CE research field is low with heterogeneous distribution of research outputs across subject areas. This is also evident in **section 2.4.1** where the majority of the papers were linked to environmental subject/research area, as shown in **Figure 8**. Moreover, the findings from **section 2.4.3** on keywords co-occurrence analysis revealed the majority of the keywords used are related to the environmental aspects of the CE, suggesting a potential concentration on the environmental dimension by the research community, hence overlooking the multi-dimensionality and complexity of the CE.

2.5 Content analysis

2.5.1 Theories and theoretical frameworks underpinning the circular economy

The CE concept was initially introduced more than 50 years ago, in the work of Boulding (Cramer, 2020; Avdiushchenko, 2018). According to Boulding (1966),

The closed economy of the future might similarly be called the 'spaceman' economy, in which the earth has become a single spaceship, without unlimited reservoirs of anything, either for extraction or for pollution, and in which, therefore, man must find his place in a cyclical ecological system which is capable of continuous reproduction of material form even though it cannot escape having inputs of energy.

Early schools of thought began shaping the theoretical foundations of this inevitable transition from a linear economy to a new economic model. According to Scarpellini et al. (2019), the main schools of thought associated with CE are those of the functional service economy, natural capitalism, and 'cradle-to-cradle' principles (Aranda-Usón et al., 2020; Barbero and Pallaro, 2018). The work of Pearce and Turner (1990) has been flagged as pivotal in the introduction of CE, with the concept used to explicate the functioning of the economy while considering the implications of the environment-economy nexus (Scarpellini et al., 2019). Nevertheless, as Avdiushchenko (2018) points out, opponents of this early notion of establishing CE on closed loops argue that, *'the economy of nature is based on an open system, not a closed system, that nature operates using short cycles, not extended lifetimes, that nature is sub-optimal, not optimal, and that nature is eco-inefficient, not eco-efficient'* (Skene, 2018). In more advanced phases, CE is situated within the field of industrial ecology (IE) (Goncalves et al., 2021; Henrysson and Nuur, 2021; Aranda-Usón et al., 2020; Cramer, 2020; Scarpellini et al., 2019; Van den Berghe and Vos, 2019; Barbero and Pallaro, 2018), industrial symbiosis (IS) (Cramer, 2020; Barbero and Pallaro, 2018; Lombardi, 2017), ecological economics (Goncalves et al., 2021; Henrysson and Nuur, 2021), and environmental economics (Henrysson and Nuur, 2021).

Moreover, Nohra et al. (2020) claim the notion of eco-effectiveness, originating from the cradle-to-cradle principle and industrial ecology, has been engrained in the CE paradigm. Van den Berghe and Vos (2019) revisited the pivotal work of Wachsmuth (2012) on the three ecologies of urban metabolism, namely, the human ecology, the (urban) industrial ecology

and the (urban) political ecology, and ultimately are situating the operational concept of circularity within the industrial ecology. According to Banaite and Tamošiuniene (2016) the CE concept, initially put forward by the EC in a report of 1976, is perceived as an outcome of implementing sustainable development globally, while Drejerska et al. (2020) claim the theoretical basis of the CE is founded on the material cycles idea.

Several papers in the final dataset used different theories and theoretical frameworks to conduct their studies. In their pivotal work Brand and De Bruijn (1999) attempted to develop a regional practical perspective of the theories of ecological modernisation and proposed a model of industrial ecology which could be advantageous for implementing the concepts of shared responsibilities and ecological modernisation.

Barbero and Pallaro (2018) argued that the methodology of system design, engrained in complexity theories, generative science, system thinking and ecological economics, can support the CE transition, by addressing prevailing challenges. Similarly, Nohra et al. (2020) explored how system design can contribute to devising policy actions embedded in the regional context but at the same time supporting an interregional CE shift. Drejerska et al. (2020) constructed their study on the systems theory, assuming that systems approach for waste management that SMEs adopt at regional scale, will enable them to detect the underlying factors for effective implementation of CE practices. Whicher et al. (2018) argued that ecosystems theory has been applied in some European Union (EU) Member States (MS) as a method to devise their national design policies, and in that context, they analysed how design-driven innovation can be entrenched into regional CE action plans.

Goncalves et al. (2021) analysed the progress of CE initiatives using the innovation economics literature stream, particularly the environmental innovation, with the argument that eco-innovation is fundamental for CE transition. In an effort to identify the roles which systemic intermediaries (so-called 'transition brokers') can undertake in the regional governance of adopting CE, Cramer (2020) used innovation science, specifically transition management and technological innovation systems approaches. In their study Ortega Alvarado et al. (2021) applied the framework of discourse coalitions, which availed them to detect different CE visions as stabilized or institutional discourses and their structuration (or existence) between different stakeholders. In order to investigate the way diffusion of CE as a political and future-

oriented notion is appropriated via symbolic, practical, and cognitive dimensions, Sutcliffe and Ortega Alvarado (2021) adopted the model of domestication using qualitative data from the region of Trøndelag and Oslo. The deployment of domestication framework avails investigation on the influence of locality and cultural contexts in the exertion of global policies. Real et al. (2020) are adopting the cosmopolitan localism perspective, advocated by Manzini (2013), and defined as a web of *“interconnected localities, where many important decisions are made locally by the people directly concerned, and more importantly, where for each step of the process of production and consumption, much of the decision-making, know-how and economic value remains in the hands, minds and pockets of the local communities”*. From this point of view, the CE can be designated as a network of smaller CEs with the main development is located in cities and regions (i.e. local sites) with active involvement of local actors. This viewpoint is closely linked to the concept of bioregionalism (Georgescu-Roegen, 1993), distributed economy (Johansson et al., 2005), degrowth (Demaria et al., 2013), diseconomies of scale and opposition to bigness (Kohr, 1957) or conviviality (Illich and Lang, 1973); all of them inducing socio-technical transition in small scale areas such as cities or regions.

The paper of Ingstrup et al. (2021) clarifies the institutional logics of academia and practitioners within industry and government, along with the alignment and misalignment arising when these stakeholders cooperate. Based on the theories of alignment and misalignment and institutional logics, an explorative study of a CE cluster from the Tampere region (Finland) is performed. Agovino et al. (2020) presented the importance of institutional quality factors (voice and accountability, government effectiveness, regulatory quality, rule of law and control and corruption) for the adoption of effective separate collection of recyclable waste materials in 103 Italian provinces (NUTS 3 regions), between the years 2004-2011. Henrysson and Nuur (2021) reflected on the importance of institutions in the establishment of new development routes in regional industrial development in the CE arena. In order to comprehend the driving forces and obstacles for shifting the sociotechnical systems in natural resource-dependent regions towards being more circular, an inquiry of several factors was made, including facilitating and restricting role of institutions, the local circumstances of transformation, institutional interplay, and patterns of lock-ins. The study of Alonso-Almeida and Rodríguez-Antón (2020) applied the institutional theory to examine the role of institutional pressures (coercive, normative, and mimetic) on the diffusion and application of

CE from the state to the regions. The findings showed coercive and then mimetic pressures were the most influential one for the development of CE initiatives in Spanish regions, while normative pressures were not so pertinent. This study and its results are crucial for providing guidance on how to advance the CE transition by applying different types of institutional pressures. Additionally, this seminal work and findings will shape the theoretical framework of the thesis.

2.5.2 Mapping the studies based on NUTS classifications

This study draws on the NUTS classification – more specifically the NUTS 2 level regions – as a unit of analysis for regional CE implementation. To map the final dataset against the three levels of NUTS regions, **Table 15** was created and populated according to the data in **Appendix A**, and a quantitative content analysis was performed afterwards. In the first column, all the articles were listed, and in the next five columns, a categorisation was developed based on the NUTS classification. Therefore, three categories were corresponding to the three NUTS levels, NUTS 1 having from 3 to 7 million population, NUTS 2 800 000 to 3 million and NUTS 3 from 150 000 to 800 000 population. However, some papers were referring to sub-national territories which were either larger than NUTS 1 regions or smaller than NUTS 3 regions, in terms of population, and these two additional categories were introduced respectively.

Five categories were developed: ‘indicated region(s)’, ‘considered as region(s)’, ‘multiple levels’, ‘suggested level’, and ‘N/A’. The number of categories, represented by triangles and “-”, corresponds to the number of regions mentioned in the paper.

The ‘indicated region(s)’ categorisation includes papers which clearly specified an existing region or territory, regardless of the context in which it was stated. For instance, Henrysson and Nuur (2021) brought up the following regional examples of CE initiatives across the EU - Päijät-Häme region of Finland (NUTS 3), Brussels-Capital Region (NUTS 2), Malopolska region of Poland (NUTS 2) and Extremadura in Spain (NUTS 2). In contrast, Arbolino et al., (2018) used the regional data of 20 Italian NUTS 2 regions to test their developed index measuring ecological industrial policy – Industrial Environmental Sustainability Index (IESI). Other contributions falling under this category are Whicher et al. (2018), referring to the UK’s

NUTS 1 region – Scotland; Barbero and Pallaro (2018) mentioning the Italian NUTS 2 region of Piedmont; and Virtanen et al. (2019) pointing out to the Finish NUTS 3 region of Päijät-Häme.

In the second category of “considered as region(s)”, the authors are primarily referring to large cities that Eurostat does not regard as NUTS regions, but which for the purpose of this research are considered to belong to one of the five proposed levels, solely based on their population. These papers were included because of the relevance of their content and contribution to this research. One of these cases is the study of Dąbrowski et al. (2019), which looks at the Amsterdam and Naples metropolitan areas. These are not NUTS regions, but based on their population, they could logically be considered NUTS 2 and NUTS 1 regions, respectively. Obersteg et al. (2019) focus on the following urban regions (and their peri-urban areas): Amsterdam, Naples, Ghent, Pécs, Łódź, and Hamburg. Taking into account the population of these regions, they could be considered as NUTS 3 regions, apart from Pécs study area, which is smaller than NUTS 3.

On some occasions, Eurostat data indicate that an area could represent more than one NUTS level, as is the case with the Brussels capital region, which is NUTS 1, 2, and 3 level in the study of Christis et al. (2019). Similarly, the French region of Pays de la Loire is both NUTS 1 and NUTS 2 level in the paper of Vanhamaki et al. (2019). Another example is the study of Alonso-Almeida and Rodríguez-Antón (2020), where some of the Spanish regions the authors are analysing according to Eurostat are both NUTS 2 and NUTS 3 levels (i.e. Asturias, Cantabria, Ceuta, Melilla and Muccia). This third category is represented by the green triangle in the category of ‘multiple levels’.

The ‘suggested level’ category indicates that the author(s) proposed a specific NUTS level, though exact regions/territories were not named. For example, Avdiushchenko (2018) proposes that NUTS 2 regions are the most suitable one for implementing CE but makes no reference to any specific region.

Finally, five papers were generic and did not specify any region or territory, though they had regional considerations; hence, they were grouped in the ‘N/A’ category (Bezama et al., 2019; Marra et al., 2018; Lombardi, 2017; Banaite and Tamošiuniene, 2016; Zhu and Ruth, 2014).

Study/NUTS categorisation	> NUTS 1 (>7m)	NUTS 1 (3m-7m)	NUTS 2 (800k-3m)	NUTS 3 (150k-800k)	< NUTS 3 (<150k)
Towa et al. (2021)	△	▲ ▲ ▲			
Yu et al. (2021)				▲	
Stanojev and Gustafsson (2021)			▲ x 243		
Ortega Alvarado et al. (2021)			▲		
Kaya et al. (2021)				▲ ▲ ▲	△
Vanhamäki et al. (2021)		▲ ▲	▲ x 6	▲ ▲ ▲ ▲	
Sani et al. (2021)			▲		
Henrysson and Nuur (2021)			▲ ▲ ▲	▲	
Towa et al. (2021a)		▲ ▲ ▲			
Sutcliffe and Ortega Alvarado (2021)			▲	△	
Gonçalves et al. (2021)	△				
Towa et al. (2021b)		▲ ▲ ▲			
Lechner et al. (2021)				▲	
Boffardi et al. (2021)			▲		
Tazi et al. (2021)		▲ x 7; ▲ x 6	▲ x 6		
Ingstrup et al. (2021)				▲	
Poponi et al. (2020)			▲		
D'Adamo et al. (2020)			▲ x 20		
Agovino et al. (2020)				▲ x 103	
Compagnoni (2020)			▲		
Cappellaro et al. (2020)			▲		
Arbolino et al. (2020)			▲ x 20		
Savini and Giezen (2020)				▲	
Cramer (2020)			▲ ▲ ▲ ▲ △	▲ ▲ ▲	
Nohra et al. (2020)		▲ ▲	▲ ▲ ▲		
Silvestri et al. (2020)			▲ x 169		
Vanhamäki et al. (2020)				▲	
Alonso-Almeida and Rodríguez-Antón (2020)		▲	▲ x 13; ▲ x 5	▲ x 5	
Sánchez Levoso et al. (2020)				▲ x 5	△ △ △
Aranda-Usón et al. (2020)			▲		
Santagata et al. (2020)					△
Real et al. (2020)		▲			
Drejerska et al. (2020)			▲		
Bianchi et al. (2020)			▲ x 280		
Banias et al. (2020)			▲		
Gardiner R., Hajek P.			▲ x 284		
Kokkinos et al. (2020)			▲		
Amenta and Qu (2020)		△	△		
Patricio et al. (2020)				▲	

Foschi et al. (2020)			▲		
Cossu et al. (2020)			▲		
Scarpellini et al. (2019)			▲		
Bezama et al. (2019)	-	-	-	-	-
Agovino et al. (2019)					~ ▲ x 8000
Paletta et al. (2019)			▲		
Savini (2019)				▲	
Virtanen et al. (2019)				▲	
Alaerts et al. (2019)		▲			
Obersteg et al. (2019)				▲▲▲▲▲	▲
Dąbrowski et al. (2019)		▲	▲		
Van den Berghe and Vos (2019)					▲▲
Grippio et al. (2019)			▲▲		
Volk et al. (2019)		▲			
Gravagnuolo et al. (2019)	▲		▲▲▲	▲▲▲▲	
Avdiushchenko and Zajaç (2019)			▲		
Christis et al. (2019)		▲	▲	▲	
Vanhamaki et al. (2019)		▲	▲▲▲▲	▲▲	
Mihai and Grozavu (2019)			▲		
Avdiushchenko (2018)			△		
Smol et al. (2018)			▲		
Andretta et al. (2018)			▲▲		
Marra et al. (2018)	-	-	-	-	-
Husgafvel et al. (2018)				▲	
Husgafvel et al. (2018a)				▲	
Whicher et al. (2018)		▲			
Aranda-Usón et al. (2018)			▲		
Barbero and Pallaro (2018)			▲		
Patricio et al. (2018)				▲	
Sastre et al. (2018)		▲▲	▲ x 9; ▲ x 8	▲ x 7	
Arbolino et al. (2018)			▲ x 20		
Lombardi (2017)	-	-	-	-	-
Taddeo et al. (2017)			▲ x 7		
Banaite and Tamošiuniene (2016)	-	-	-	-	-
Taddeo (2016)			▲ x 9		
Daddi et al. (2016)			▲		
Iacondini et al. (2015)			▲		
Tessitore et al. (2015)			▲▲▲		
Cutaia et al. (2015)			▲		
Zhu and Ruth (2014)	-	-	-	-	-

Mirata and Emtairah (2005)					△
Mirata (2004)		▲ ▲	▲ ▲		
Brand and De Bruijn (1999)			▲	▲	△

Table 15: Distribution of different NUTS level regions in the final dataset (**Note:** '▲' indicated region(s); '△' considered as region(s); '▲' multiple levels; '△' suggested level; '-' N/A)

Most of the analysed paper were mapped in the NUTS 2 region (thirty-five papers), followed by NUTS 3 region (twelve papers) and NUTS 1 region (six papers). Only one paper was belonging to territory larger than NUTS 1 region based on the population, and four papers to smaller areas than NUTS 3 regions in terms of population. As already mentioned above, five papers were general and did not indicate any specific region or area. Finally, nineteen papers mentioned multiple regions belonging to at least two categories, like Nohra et al. (2020) reporting on the results from the RETRACE Project, which involved partners from Piedmont (NUTS 2), Basque Country (NUTS 2), Nouvelle Aquitaine (NUTS 1), Northeast Romania (NUTS 2) and Slovenia (NUTS 1). The results from this quantitative content analysis presented in **Table 15** show the tendency of scholars to focus on the NUTS 2-sized regions, which supports the argument of this research to base the sub-national implementation of CE precisely on the NUTS 2 level regions.

2.5.3 Pillars of CE: Industrial Ecology, Industrial Symbiosis and Eco-Industrial Parks

IE, presented in the literature as both policy tool and academic theory (Daddi et al., 2016) concerns the impact of industry, technology and related changes in society and economy on the biophysical environment (Taddeo et al., 2017; Taddeo, 2016). The IE discipline, according to Mirata and Emtairah (2005) encourages new ways of tackling environmental issues at regional and local level. Two main place-based approach are vital within the IE, Eco-Industrial Parks (EIPs) and IS (Mirata, 2004).

According to Taddeo (2016) IE offers sustainable approaches for local development, mostly manifested through establishing EIPs, which are the global referential models for delivering IE locally. EIPs are formed and managed as community of enterprises, with the primary goal of attaining environmental, economic, and social advantages via collaboration and synergies. In terms of establishment, EIPs can arise spontaneously from bottom-up initiatives coming

from the industry, or top-down planned approach driven by government or academic, the former being more resilient and having greater chances of success. Moreover, an EIP can be formed as new industrial site (greenfield), could involve reindustrialisation of abandoned industrial area (brownfield), or transform currently functioning industrial areas (Taddeo, 2016).

IS, also known as regional industrial system, denotes synergetic activities between companies where the waste of one company can be considered an input to another company, entailing materials, energy, services, and facilities (Henrysson and Nuur, 2021; Yu et al., 2021; Patricio et al., 2018; Lombardi, 2017; Taddeo et al., 2017; Taddeo, 2016; Iacondini et al., 2015). This network created by industries to share resources and minimize waste production (Vanhamaki et al., 2019; Lombardi, 2017), originated from the eminent example of the Kalundborg (Denmark) industrial facilities (Yu et al., 2021). According to Savini (2019), prototypes that precipitated recent models of CE originate from the late 1970s, when industrial manufacturing groups started investing in IS and successful industrial design. Nonetheless, the literature on IS is deemed to be theoretically fragmented (Aranda-Usón et al., 2020).

Despite the already presented theoretical links between the concept of CE and IS, scholars perceive the nexus between these two concepts differently. For instance, the IS is presented as: one of the most effective enablers for the CE transition, a mechanism to develop the CE (Yu et al., 2021), one of the dominant strategies of a CE (Patricio et al., 2020; Patricio et al., 2018), very beneficial tool for the exchange of waste and formation of networks for developing CE (Poponi et al., 2020; Lombardi, 2017; Iacondini et al., 2015), territorially-bound enabler (Gravanguolo et al., 2019), an early prototype of circular production (Savini, 2019), mechanism for implementing the CE at the regional level, along with eco-parks (Scarpellini et al., 2019) and an approach which strengthens the idea of CE (Vanhamaki et al., 2019). Last but not least, scholars established the bond between IS and CE in terms of implementation levels. More specifically, the IS is predominantly considered as a meso level of implementing the CE transition (Vanhamäki et al., 2020; Avdiushchenko and Zajač, 2019; Marra et al., 2018).

The crucial role of the IS within the European CE strategy is also acknowledged in the literature (Compagnoni, 2020; Patricio et al., 2020; Husgafvel et al., 2018; Husgafvel et al., 2018a; Lombardi, 2017; Iacondini et al., 2015). According to Lombardi (2017) from local,

regional, national to EU level, the IS is perceived as a strategic tool contributing to the CE, however, less than 0.1% of the 26 million active companies in Europe are acknowledged as operating within a symbiotic partnership. The European Resource Efficiency Platform (EREP) identified Industrial Symbiosis (IS) as one of the mechanisms for reducing CO₂, preserving critical resources, and safeguarding business sustainability. The role of IS to global agendas such as the CE was acknowledged by global institutions (UN, OECD) and prominent global fora (G7, G20, Global Green Growth Forum¹, and World Circular Economy Forum). The EC Communication Closing the loop – An EU action plan for the Circular Economy – supported innovative industrial processes like the IS, and the 2015 CE package highlights the IS as a key strategy for implementing CE (Lombardi, 2017; Iacondini et al., 2015).

Except EU countries, Japan and China also engaged in the advancement of IS and industrial parks. Japanese port cities experimented to a large degree with the model of IS, and the Japanese archetype of IS was employed in Europe, for example in the cases of Dunkerque in France and Kalundborg in Denmark (Gravagnuolo et al., 2019). While in China, the National Development and Reform Commission of China (NDRC) began the initial CE pilot projects in 2005, including 105 enterprises, 37 industrial parks, and 36 industrial regions. Four years later, the CE Promotion Law was enforced, and in 2015 the NDRC began another programme concentrated on cities (Gravagnuolo et al., 2019; Avdiushchenko, 2018). As a way of promoting the adoption of CE and assist the policymaking procedure, the NDRC introduced two sets of CE indicators; one for assessing the CE application in each region and the country generally, and one for evaluating the stage of CE advance in industrial parks (Avdiushchenko and Zajac, 2019, Alaerts et al., 2019).

Several studies in the final dataset were exploring the link between existing or potential IS networks and the CE in different European regions. Aranda-Usón et al. (2020) reported that activities concurrent with recycling and energy efficiency are the most frequently encountered ones and regarded as the initial phase of CE implementation. Contrary to this, interventions associated with IS and sharing economy are not so regularly adopted, but its these activities which are considered as the most advanced stages of the CE realisation (Aranda-Usón et al., 2020). As part of the mapping exercise of CE good practices in the Italian Emilia-Romagna region, Cappellaro et al. (2020) identified the Roveri smart village where IS applications were recorded. Yu et al. (2021) conducted an exploratory study in the Twente region (The

Netherlands) and discovered existence of implicit IS practices in the construction industry. The findings of the analysis recommended the up-cycling efficiency as fundamental for IS development. Additionally, imperative policy implications for CE were provided: 1) employing rigorous waste sorting on-site for safeguarding waste purity, 2) setting up information-sharing platform and 3) offering subsidies targeting up-cycling tech innovation and circular business models to expand the collaboration space (Yu et al., 2021). In order to improvement the cross-company ecology and symbiosis, the results from two studies indicated the following was needed: life cycle thinking and evaluation, advance of material efficiency and supervising of material flows, replacement of non-renewable with renewable natural resources and boosted collaboration and communication among different stakeholders. In terms of the public steering actions, the companies emphasised the importance of energy and fuel policy, financing, investment, innovation, the local operational setting, communication, and education (Husgafvel et al., 2018).

The Polish Malopolska region also began its CE transition via IS. Specifically, the Marshal Office of the Malopolskie Voivodeship participated in the international Interreg EU project 'Industrial Symbiosis for Regional Sustainable Growth and a Resource Efficient Circular Economy' (SYMBI), which aims to advance the adoption of regional development policies linked with CE and IS (Avdiushchenko and Zajać, 2019; Smol et al., 2018). Initially, the project partners, regional authorities from Poland, Finland, Spain, Italy, Hungary, Greece, and Slovenia, identified best practices of IS in their regions. Except having promotional role, the partners actions also contributed to introducing the CE concept in the operational and strategic documents of the regions. In 2017 the Waste Management Plan of Malopolska was updated with CE assumptions and waste management targets were stated; IS was selected as one of the main instruments for the deployment of these policies. The participation in the SYMBI project enables the regional authorities of Malopolska to identify the most effective mechanisms for CE implementation, building up on the experience of the more advanced partners, from Finland, Spain, and Italy, and assess how their good practices can be initiated in the region. Lastly, the Spatial Management Plan for the Malopolska Region should be amended, since spatial management strategy can decide the introduction of IS and arrangement of regional public spaces for building favourable conditions for CE development (Avdiushchenko and Zajać, 2019).

The spatial regional development area is considered very relevant in the Chinese CE approach, though in the EU approach it is still an area with great potential because it can incorporate CE premises into land-use planning, therefore encouraging CE-related instruments like industrial and urban symbiosis. By taking into account the spatial area of CE-based regional development, areas such as the public transportation infrastructure and public space organisation could be enhanced in terms of CE practices. Hence, the inclusion of the spatial effective economy as one of the main pillars for the development of the CE regional monitoring framework (Avdiushchenko, 2018).

Vanhamaki et al. (2019) are directing their efforts on the bio-based CE, stating that regional authorities' support and encouragement for cooperation in the bio-economy sector is a "springboard" towards IS between facilities which use different biological streams, and ultimately contribute to larger CE application. Patricio et al., (2020) applied their proposed framework to an IS case in the biogas production, as it is one of the main growth priorities in the Västra Götaland region. This investment in the biogas production is projected to open 3,000 full-time positions in the region. The study practically applied the developed framework, where industrial waste with high prospective use in biogas production were enumerated and mapped in the Västra Götaland region. The results revealed that out of 49 municipalities, 11 create enough waste which could be repurposed for biogas production. The findings were considered as principal indication for commencing a collaborative project with a possible IS facilitator - Hållbar Utveckling Väst, the regional energy agency (Patricio et al., 2020).

Another study explored the challenges and stimuli encountered by Small and mid-size enterprises (SMEs) in the Västra Götaland region regarding the IS. In terms of drivers to engage in symbiotic activities the SMEs listed economic rewards, environmental performance, and new business opportunities, while main challenges were time limitations, struggle to find receivers and lack of knowledge. The findings highlight the influence of local facilitators in connecting companies to develop symbiotic partnerships, as well as the need to focus on identification of possible users of waste, rather than investments in new technologies (Patricio et al., 2018). The study of Lombardi (2017) contributed to unveiling non-technical barriers and drivers to CE through IS, highlighting barriers reported by companies and practitioners such

as, market failure of information, organisational and governance (regulation and policy). The role of facilitator is suggested as a mechanism to address the uncovered barriers.

One of the three aims of the Päijät-Häme bio-based CE action plan is to enhance the use of bio-products and bioenergy with regional companies, i.e. bio-based IS. In this Finish NUTS 3 region, the local bio-based industrial symbiosis (LABIO Ltd) where biogas and fertiliser are manufactured from biowaste streams and sewage sludge, is one of the innovative CE business concepts. Both the regional strategy and IS LABIO have been acknowledged as good practices at the EU level, and showcased on the Interreg Europe's Policy Learning Platform, as outstanding and more importantly transferable practices of how to adopt regional CE (Vanhamäki et al., 2020).

Mirata and Emtairah (2005) presented observations from the Landskrona industrial symbiosis programme (LISP). LISP was funded by the Swedish Business Development Agency (NUTEK) and initiated in 2003, with more than 20 enterprises and three public actors that managed infrastructure, environmental affairs and business developed. Mirata (2004) examined the underlying elements of regional IS networks, from the IS programmes in Humber, West Midlands, and Mersey Banks regions, and considered the role of coordination bodies in catalysing the success of symbiotic partnerships. Overall, the UK's policy landscape was supportive of IS network developments as well as the regional public authorities. The main factors determining the progress of the IS programmes were type of enterprise's activities and industrial history of the region, degree of peer pressure, placement of coordinating body and its approach to raise awareness and recruitment. The role of the Business Council for Sustainable Development-UK (BCSD-UK) was highlighted, as ground-breaking and encouraging formation of IS programmes in UK regions, and initiating the national IS programme (NISP), serving as an umbrella for various regional IS programmes.

In their study, Ingstrup et al. (2021) are focusing on the CE cluster in Finland's Tampere Region, which dates back to 1800s when the region was experiencing its industrial blooming and industries like textile, metal and forest developed. More recently, other industries have extended the focus of the cluster, including high-tech, health and information technology (IT). Currently, the emphasis is on CE which is explained by three factors. Firstly, energy and eco efficiency have been in the focal point for both industry and academia for many decades.

Secondly, for the last 25 years the region has accommodated multidisciplinary research in sustainable development, leading to developing a complex environmental regional expert knowledge. Last but not least, from 1970s when the recognition of the planetary boundaries emerged, the aims and measures of the government were directed towards recycling and minimising waste. The policy-driven cluster counts over 300 industry stakeholders, more than 20 governmental (regional and municipal authorities) and 10 academic actors (local technological universities and national research organisation) (Ingstrup et al., 2021). In details, the eco-industrial park (EIP) ECO3 in the city of Nokia is studied in the work of Ingstrup et al. (2021). The case of ECO3 provided benefits to all involved actors, providing new business opportunities for companies, development of new technology and knowledge for academia and reducing unemployment and contributing to sustainable city development for the government. Even though the initial idea originated from a bottom-up industrial initiative, the involvement of the municipal business development agency (government actor), identified an opportunity to establish an EIP and therefore was instrumental for the success of the ECO3 (Ingstrup et al., 2021). The study of Tessitore et al. (2015) was on the EIP development and integrated management challenges from the Italian context, and the role of the management body with designated responsibilities by national law to manage and coordinate enterprises and contribute to more environmentally sustainable production practices.

Taddeo et al. (2017) outlined an interesting context to study, related to the expansion of IS activities. Specifically, they looked at Innovation Poles (IPs), government-sponsored consortia, formed by EU programs with the ultimate goal of encouraging innovation in a network of organisations in particular industries or value-chains at local and regional level. The study concludes the advantageous role IP models could have in development and diffusion of IS on specific spatial level. This is due to two main reasons, their territorial activity of production and dissemination of knowledge and innovation, and (if regarded as applicative contexts for IS) their support in creating symbiotic partnerships (Taddeo et al., 2017). Zhu and Ruth (2014) proposed three ways of forming IS networks dependent on institutional settings - preferential growth under self-organisation, homogeneous growth under coordination and facilitation, and random pairing under planning and policy

promotion. The results from their work, including a diverse sample of 15 IS networks with 204 companies, implied that preferential growth is a prevailing process in self-organised systems, designating a persistent disparity of firm's competences in developing IS.

Ecologically Equipped Industrial Area (EEIA), introduced by national law in Italy in 1988, represent the most important model for the sustainable local development in Italy. However, more than two decades since the law entered force, and the model did not have full and functioning adoption in Italian regions. Only nine out of 20 Italian NUTS 2 regions have incorporated it (Taddeo, 2016), and one of the most advanced regions is Emilia Romagna that promulgated regional law on CE in 2015, where EEIA became the reference and obligatory model for every new type of local industrial systems developed in the region (Taddeo et al., 2017). Some of the primary challenges included long time for return on initial investment, regulatory restrictions for exchange of waste, and the planned top-down approach making the procedure inflexible and bureaucratic (Taddeo, 2016).

Another Italian region, proved as pioneer in the application of IE as a policy tool is Tuscany, launching the first EU environmental and industrial policy of a voluntary instrument targeting the development and diffusion of EIPs. Namely, the regional law known as Tuscan Regulation 74/2009 and Resolution 1245/2009 set the foundations for the scheme and criteria to avail the EIPs to voluntarily achieve EEIA (known also as APEA in Italian). The management body (MB), mixed public-private company having the facilitators' role in the IE area, had very prominent role to ensure proactive involvement of public and private actors and cooperation, support specific instruments for EIPs and frequent monitoring of the environmental objectives. Another novelty with this certification standard was the full regional management, and the non-involvement of the central government. More specifically, the regional government oversaw the implementation of the scheme and ensured compliance with regionally set criteria. Provincial governments contributed to territorial coordination and efficient use of land, while municipalities were selecting the location for the EEIA, identify the MB and confirm the alignment of the industrial site with the EEIA certification yardsticks (Daddi et al., 2016).

Iacondini et al. (2015) evaluated existing opportunities and ongoing projects in the Emilia Romagna region envisioned to apply IS and implement CE. The regulatory landscape at EU,

national and regional level is outlined, presenting the IS encouragement in all EU Cohesion Policy and research and innovation agenda (e.g. Horizon 2020) and also Italian regional policies (e.g. Smart Specialisation Strategy (S3) – Emilia Romagna Regional Policies). The focal point of the paper is the analysis of Italian experiences and projects at national, regional, and country level. At the EU level, the work of Climate-Kic, one of three Knowledge and Innovation Communities (KICs) formed in 2010 by the European Institute of Innovation and Technology (EIT), was presented. In particular, the Pioneers into Practice (PIP) was analysed into details, aiming to contribute to low carbon culture, involving enterprises and societal actors in order to tackle environmental and climate challenges. The outcome of the PIP activities showed that Italian regulatory framework is more severe and complex, compared to the rest of Europe, hence, development of technical guidelines and simplifying the regulation is needed to encourage diffusion of IS practices. At the regional level, the “GREEN-Industrial Symbiosis” project was analysed in detail, which was developed by Unioncamere Emilia-Romagna (Union of Emilia-Romagna Chambers of Commerce, Industry, Trade and Agriculture) and Aster S. Cons. P.A. (the consortium for innovation and technology transfer in Emilia-Romagna), with the scientific assistance of ENEA UTTAMB (Italian National Agency for New Technologies, Energy and Sustainable Economic Development—Environmental Technologies Technical Unit). The project’s focus was on disseminating IS culture in the region and connecting industries which were unconventional in establishing symbiotic partnerships. The results emphasised the existing enabling ecosystem for IS diffusion, though hesitations were observed due to permission procedure and the sharing of internal data. At the country level, the Community Supported Agriculture (CSA) project was investigated, and the study on the Waste Cycle. The CSA is a model supporting the local economy, in the agriculture and distribution sector, and the main goal of the project was to upsurge territorial recovery, combined with environmental, economic, and social advantages. Overall, this paper revealed that both industrial and academic ecosystems are supportive and interested of IS, but regulatory and cultural issues are the main obstacles observed (Iacondini et al., 2015).

Cutaia et al., (2015) reported the activity, fostered by the Italian agency for new technologies, energy, and sustainable economic development (ENEA), within the project for creating and implementing the first Italian Platform for IS in Sicily (2011-2015). The two main objectives

were to develop a methodology and an instrument for IS application at the regional level, and to apply an IS platform as a support to SMEs to identify their opportunities for IS within the region.

The earliest work in the dataset was the one of Brandt and Brujin (1999), where the author's intention was to contribute to the debate concentrated on sustainable industrial development at the regional level, more specifically at industrial estates. The main question is which model can be utilised to assist the application of shared responsibility and ecological modernisation concepts. In simple words, the study is investigating the possible added value of IE approaches in encouraging industries towards sustainability and the opportunities it provides to local and regional authorities to address environmental issues.

2.5.4 Circular economy policymaking: analysis of different levels of circular economy policies

According to Scarpellini et al. (2019), the contribution of local and regional authorities to the introduction of and transition to a CE is vital; hence, the CE should be translated into environmental regional planning. This implies the enduring economic restructuring of the territory, which will ultimately accelerate the formation of integrated markets. The progress of CE in a territory, however, depends on various aspects, including industrial structure, regional business, level of innovation, and legislative profile at the regional and local level. Generally, European medium-and long-term development CE policies are parts of the multilevel interaction of environmental legislation, and actors from the quadruple helix model are taken into account during this process (Scarpellini et al., 2019). Nevertheless, the integrated nature of planning – involving environmental, social, and economic factors – can result into cases where economic aspects take precedence over local development (Datta, 2012; Pickvance, 2000).

The crucial role of regional authorities in initiating and promoting the CE implementation, as argued by Bacova et al. (2016) consists of establishing framework conditions or directly encouraging local and regional actors (Silvestri et al., 2020). Moreover, according to Bacova et al. (2016), *“since CE implementation is affected by geographic, environmental, economic and/or social factors, the diversity of territorial contexts translates into different needs and opportunities that any CE approach should address, so that regions with higher green performance might need less support*

with the transition to CE than other region". Lechner et al. (2021) adds that even though policymaking is perceived as mainly (trans)national way to address sustainability issues on large scale, local authorities have important influence on climate mitigation activities. More specifically, Cramer (2020) and Vanhamaki et al. (2020) claim that national governments started engaging in the CE transition, but the adoption of the CE in cities and regions is still in infancy phases hence related research is also meagre. Another challenge not investigated is the inclination of industry to innovate in the direction towards CE, on which the local governments heavily rely on for effective shift (Cramer, 2020).

The results from a recent study revealed that transition brokers envisage the following roles to be assumed by provinces (Dutch NUTS 2 regions) in regard to the CE: CE policy development, adjustment of policy instruments to incorporate CE, execute CE policy, encourage employment and new CE businesses and support innovation and learning networks on CE (Cramer, 2020). Kokkinos et al. (2020) stresses the role of regional authorities in the renewable energy transition, being mostly directed towards spreading awareness and informing the local society and industry for the benefits emerging from actions towards cleaner technologies. The regional level is perceived to be crucial also for employing waste management policies since regions and municipalities are accountable for separate collection systems and for creating and overseeing treatment facilities. Findings show that traditional economic development strategies do not suffice to decrease waste creation in European regions, and in order to stimulate a regional shift towards CE economic instruments like charges and incentives, along with eco-innovation tools shall be initiated (Gardiner and Hajek, 2020).

Sanchez Levos et al. (2020) acknowledged the role of global policies in setting the general ambition for the CE shift but stressed the importance of local interventions to put into practice the general ambition. Therefore, they developed a methodological framework to avail better understanding and application of CE strategies in urban systems (i.e. urban cities and urban regions). The methodology includes four stages, where 1) the context of the urban system is initially analysed (to understand the reality of the territory, 2) the implementation scope is selected (identify areas with the greatest potential for CE implementation), 3) the CE opportunities are identified and 4) the implementation roadmap is designed. Kaya et al. (2021) conducted a study with the goal to investigate the driving forces and related policy tools that

support adaptive reuse actions, and to explore the usefulness and viability of different multi-level policy enablers at diverse local contexts.

Savini (2019) claims the popularity of CE policymaking has gained momentum along with a culture of ecological production and consumption. The concept of presumption emerges in this context, emphasising the role of households (both as producers of waste and consumers of reprocessed waste materials) as vital for closing the urban chains of waste supply and demand. The outcomes of a recent study of the Brussels capital region's urban policies provide support for this conclusion. In territories with high consumption and limited production activities and resources, environmental policies must shift focus to the consumption side to impact circularity and climate change more effectively (Christis et al., 2019). Bezama et al. (2019) focuses on the regional bioeconomy, claiming that they quite often are envisioned to facilitate economic development and give rise to innovative type of economic activities and markets in the first place. Furthermore, they highlight the importance of public engagement in decision-making, contributing to increase the social tolerance for the novel bio-based systems and technologies, and therefore aid to prevent the neighbourhood symptom of NIMBY (not in my back yard). Still, up to now public engagement with local communities has been limited.

According to Marra et al. (2018), macro-level policies have effective outcomes only in closely related fields (i.e., material recovery and recycling). McDowall et al. (2017) highlight that the scale and place aspects do not receive the required attention – specifically, via financing of experimental zones on different scales. Furthermore, other aspects should have been considered, such as supporting resource-saving behaviour and promoting environmentally friendly societies with the development of ecological civilisation founded on a common vision of environmental ethics (holistic versus individualistic). Similarly, Bacova et al. (2016) promote the use of awareness campaigns by the EU to encourage the sharing economy and promote reuse and repair. They further note the importance of social innovation, particularly pioneering solutions for political and economic governance and new forms of cooperation between stakeholders.

Towa et al. (2021a) propose different CE actions for regions to increase their circularity and reduce their circularity gap, related to “*residual waste management (e.g., substitute incineration*

and landfill by waste recovery when possible), resource efficiency (e.g., use of fewer resources per unit of total output), closing supply chains (e.g., reuse, repair, refurbish), and product life time extension (e.g., decrease or delay of waste from previous stocks through the design for longevity and maintenance of durable goods)”. Nevertheless, these interventions must be developed with “integrated approach nesting inputs and outputs”, and they should not imperil a shift of environmental challenges. Additionally, in the new global economy, the interconnectedness effects of countries and regions hereditary to the CE dynamics shall be considered and incorporated into foreign policies both at EU and international scale (Towa et al., 2021). Similarly, policymakers should take into account both production and consumption sides as a basis for apportioning responsibilities to both sides for more sustainable production and consumption patterns, hence affecting positively waste management policies and general CE activities (Towa et al., 2021b).

As stated in the European Better Regulation Guidelines and Better Regulation Toolbox, rational policymaking ensures the considerate design of measures to be implemented and the meticulous assessment of their likely effects. When developing macro-level CE policies, this evaluation must be grounded in a systematic and ample understanding of the multifaceted relationships between the different systems (natural, social, and economic). However, the results of the study of Marra et al., (2018) reveal a fairly homogenous knowledge base on CE, inadequate for alleviating cross-disciplinary sharing. This could be the cause of significant challenges to successful cooperation between diverse fields, with this knowledge base vital for ensuring the quality of the policymaking process (Marra et al., 2018). Murray et al. (2017) argue that the multifaceted knowledge base that policymakers require remains in the development phase. The work of Nohra et al. (2020) investigated the impacts of CE policy design processes motivated by a systemic design and how this can avail novel and successful pathways for policy design on CE transition in European regions. Silvestri et al. (2020) reasons that in order to achieve the CE transition the support of regional policies is indispensable, since we need more concentrated approach than the national but wider than urban areas efforts. Considering that EU development strategy, i.e. Cohesion Policy is developed and applied at regional level, it is crucial to understand the way CE will penetrate in the existing development EU policy. Dąbrowski et al. (2019) claim that, despite the growing number of policies and strategies at different levels, the CE field cannot be considered mature.

Furthermore, experience and knowledge of CE implementation in spatial strategies remains insufficient. Nevertheless, policymakers and planners are keen to learn from global experiences in this emerging policy field, though the transfer of knowledge between territorial settings has not been studied to date.

Initially, the CE notion was concentrated on resource and energy efficiency and waste management. For this reason, it emerged in national, regional, and local policies as a solution to far-reaching environmental issues, resource scarcity and inefficiency, and pollution. Some of the forerunners in CE implementation were the policies of Germany (the Closed Substance Cycle and Waste Management Act of 1996) and Japan, which developed a series of laws and regulations to address waste management and recycling, beginning with the Basic Law for the Promotion of the Creation of a Recycling-Oriented Society (2001). These first initiatives provided a stimulus for Chinese policymakers, and the National Development and Reform Commission of China (NDRC) commenced the first CE pilot projects in 2005, including 178 pilot entities (105 enterprises, 37 industrial parks, and 36 industrial regions). In 2009, the Circular Economy Promotion Law of the People's Republic of China was developed as a national strategy, along with the 11th, 12th, and 13th 'Five-Year Plans'. In 2015, the NDRC introduced a new programme including 25 cities and 26 counties. China's rapid economic development has been achieved at the cost of its natural resources and environment, and the CE concept was adopted as a national policy to respond to this issue. However, the large differences in CE development between the poorer and wealthier regions remains evident (Gravagnuolo et al., 2019; Avdiushchenko, 2018).

The EU's involvement with the CE concept as a policy began in 2008 with Directive 2008/98/EC on waste and continued with the Europe 2020 Strategy for Smart, Sustainable, and Inclusive Growth for 2014-2020. The EU approach to CE has since widened and became more complex (Avdiushchenko, 2018). In 2015, the European Commission (EC) adopted the EU Action Plan for the CE, defining seven action areas: production; consumption; waste management; enhancing the market for the secondary raw materials; sector-specific innovations (in plastics, food waste, critical raw materials, construction and demolition, biomass, and bio-based products); innovation and investment; and monitoring. These EU initiatives are supplemented by local, regional, and national initiatives in the form of action

plans by the member states and their regions (Whicher et al., 2018). It is generally accepted that the CE policy approaches in China and Europe have different focuses and underlying issues. As discussed, China leans towards general environmental issues and pollution, while Europe concentrates on materials, resource efficiency, waste, new business models, new jobs, eco-innovations, and social innovations (Avdiushchenko, 2018).

The policy review performed by Stanojev and Gustafsson (2021) uncovered that CE should be perceived as a wider sustainable development strategy which should also *“support Member States and regions to strengthen innovation for the circular economy through smart specialisations”*. They add that the S3 approach will be a primary tool for detecting regions’ opportunities for progress, development, and CE. Moreover, to pinpoint a smart specialisation strategy has been regarded as a tactical element in devising investment flows and having a key role in CE value chains and processes. The work of Vanhamaki et al. (2021) presented an original approach to investigate the spatial implementation of a CE using a conceptual framework of S3 in EU regions. One of the main suggestions was regions to concentrate on precisely denoted objectives and specific but amendable plans on how to attain the targets, with the purpose to take advantage of both S3 and CE. Despite the fact that both S3 and CE are novel and still in development, hence good regional practices of combining both are still not available, the potential for synergies between these two approaches shall be acknowledged. Finally, the findings revealed that at least in some regions, promoting the CE as a strategic priority via the S3 has contributed to better identification of CE targets and interventions by concentrating on existing regional assets and potential competitive advantages.

Henrysson and Nuur (2021) highlight the need for policy interventions, beyond sectoral involvements or requirements for more circular product design, in order to transition to a more CE. Namely, they call for policy actions directed towards local factors being crucial for establishing and maintaining institutional environment supportive of CE-based transformations. Also, policy actions advancing the capacity of current industrial regional clusters are needed. Finally, they recommend strategies concentrating on differentiating and maturing markets for circular goods and services, improving cooperation among regions via knowledge and technology transfer and upholding local knowledge and expertise. They argue the importance of comprehending the institutional dynamics and instruments for

implementing CE and understanding where and what intervention is appropriate is vital for policymakers.

Resulting from the EU CE action plan from 2015, the Dutch government released a national CE programme (A Circular Economy in the Netherlands by 2050: Government-wide Programme for a Circular Economy) along with the implementation plan (Uitvoeringsprogramma Circulaire Economie (Execution programme Circular Economy) 2019–2023), instructing regions and cities to develop and implement their own CE strategies (Cramer, 2020). Sutcliffe and Ortega Alvarado (2021) studied the introduction of the CE concept in the Norwegian subnational levels, through the domestication framework in order to analyse how locality and cultural context influence the translation of global policies into local practices. The CE roadmap of Päijät-Häme region, one of the first regional CE strategies (Vanhamaki et al., 2020) devised by local government, industry, and academia, aimed to close technical and biological loops, and encourage sustainable energy technologies, new consumption models and demonstration sites (Sani et al., 2021). When the Päijät-Häme road map was launched, only big EU cities had CE strategies of plans like Circular Amsterdam (2016), Circular Glasgow (2016) and the London CE Route Map (London Waste and Recycling Board, 2017) (Vanhamaki et al., 2020). On the other hand, the focus of the Regional Programme of Brussels Capital Region was on the urban political economy of the CE (Sani et al., 2021).

Sastre et al. (2018) outlines the diverse waste management approaches among Spanish NUTS 2 regions (Autonomous Communities – ACs), and the individual responsibility of each region to complete the recycling targets set in Waste Framework Directive (WFD), as commended by the National Waste Management Plan. The results from the study revealed a policy gap among national and regional administrative levels, emerging from the absence of coordination and enforcement, which the authors illustrated with two examples. The first one links to the lack of enforcement mechanisms cascading downwards, from the national strategies to the practical regional application of the foreseen measures. The second instance transpires due to the non-harmonised national framework on landfill taxes, with only a small fraction of regions having regional landfill taxes for Municipal Solid Waste (MSW) with very low tax rates, compared to other EU MS. Alonso-Almeida and Rodríguez-Antón (2020) refer to the top-down transformation approach followed by the EU to enforce its regulations, where initially national regulations are amended and then lower-level regulations. In particular, they

use the case of Spanish regions, because the regions have some legislative powers in specific areas and operate like an independent state with respect to the principal state, hence they could be a blueprint for devising and adopting CE for other southern EU states. Their study, using the theoretical framework of institutional theory, investigated the role of institutional pressures (coercive, normative, and mimetic) in the diffusion and adoption of CE from the state to the regions. The results revealed that most efficient pressures are coercive followed by mimetic, while normative pressures were not so relevant.

Compagnoni (2020) also argues that regional authorities have indispensable role in implementing CE, because local challenges and opportunities related to CE adoption can be very specific. Three key instruments have been used by Italian regional authorities to introduce the CE principles at the regional level, namely, the Research and Innovation Strategies for Smart Specialisation (RIS3 or S3), single regional laws (RL) and Regional Waste Management Plans. The most holistic instrument is the S3, providing a multi-faceted policy mix based on medium-long run regional development ambition shared by many actors, which influences the innovation course of main economic areas. Nonetheless, only Emilia Romagna region explicitly mentioned the CE in its S3, while Piedmont and Lazio region included some close related notions to CE (e.g. clean tech, green chemistry and green economy). Several regions (Friuli Venezia Giulia, Umbria, Marche, Basilicata, and Emilia Romagna) chose the normative system to introduce regional laws on CE, mostly entailing structural interventions. These RL stipulate eco-innovation stimuli, targets and policies on waste management, and the formation of discussion platforms for stakeholders for exchange of knowledge and best practices. The vast majority of Italian regions mention CE in their Waste Management Plans, which are unsuitable for structural and systemic shift towards the CE, considering their end-of-life focus. Within these policies is the PAYT (pay as you throw) waste taxation scheme which Emilia Romagna will make it compulsory for all its municipalities before 2021 (Compagnoni, 2020). Emilia Romagna was the first Italian region to issue a CE regional law in 2015, aiming to establish regional waste management system by promoting actions and measures according to the waste hierarchy proposed by the EC, positioning waste prevention as top priority and disposal as last alternative. Additionally, the establishment of regional CE forum was also one of the regional actions (Sani et al., 2021; Cappellaro et al., 2020).

Additionally, in Italy, based on the regional self-sufficiency mechanism, each region must manage all the created waste within its borders, as enforced by the Legislative Decree 152/06. In light of that, Cossu et al. (2020) discussed the first worldwide regulation on sustainable landfilling issued in the form of regional law (D.g.r. n. X/2461), by the Lombardy region in 2014. However, one year later the guidelines were cancelled by the Regional Court of Lombardy Region (after a judicial appeal from one landfill operator), because of lack of authority of a Regional Government to enact regulations on Environmental Protection, even if these regulations are aligned to the national law. The ecological disaster in Campania region was investigated in detail as well, along with the reasons behind it and the updated Regional Plan for Urban Waste Management issued in 2016 by the Campania regional government (Boffardi et al., 2021).

On the basis of the findings in the literature, a further quantitative content analysis was performed on the final dataset of papers regarding the policies mentioned. The policies included were either those referenced by their full name or those about which sufficient detail was provided for the researcher to draw a confident conclusion. If the details were vague (i.e., 'Chinese framework', 'EU environmental policy'), the policy was not included. Additionally, if the policy was used as a citation for a definition of some concept or in support of an argument, it was not considered. The results are summarised in **Table 16**, and each triangle represents one policy. More detailed information regarding the specific names of the policies can be found in **Appendix B**. Four levels of policies were developed: *EU/international*, *national*, *regional*, and *local*. Out of 468 policies, strategies and regulations in total mentioned in the 82 papers, more than half of them were on EU and International level (52%). The regional policies were following with 23% and right after the national policies with 21%, while local strategies were represented by only 4%. A high concentration of the mentioned policies in the 82 papers is observed on the EU and international level which is somewhat expected because this type of initiatives and ambitious targets are often set at high levels (SDGs, carbon neutrality, EUGD targets etc.). However, in order these targets and objectives to be met a more local implementation is needed, hence they need to be trickled down accordingly, which according to the results did not happen, since the lower-level policies were underrepresented. All of these levels are important for the CE policymaking, each one with its own purpose and goal, and what matters the most is a unified direction and alignment between different levels.

Study/Policy	EU/International	National	Regional	Local
Towa et al. (2021)				
Yu et al. (2021)				
Stanojev and Gustafsson (2021)	▲ x4			
Ortega Alvarado et al. (2021)	▲	▲	▲ x4	
Kaya et al. (2021)	▲ x5			
Vanhamäki et al. (2021)	▲ x5			
Sani et al. (2021)	▲ x13	▲ x6	▲ x6	
Henrysson and Nuur (2021)	▲	▲	▲ x4	
Towa et al. (2021a)	▲			
Sutcliffe and Ortega Alvarado (2021)	▲ x3	▲ ▲	▲ x3	▲ ▲
Gonçalves et al. (2021)				
Towa et al. (2021b)				
Lechner et al. (2021)	▲			
Boffardi et al. (2021)	▲ x5		▲	
Tazi et al. (2021)	▲			
Ingstrup et al. (2021)				
Poponi et al. (2020)	▲ x4			
D'Adamo et al. (2020)	▲ x6			
Agovino et al. (2020)	▲ x4	▲ ▲		
Compagnoni (2020)	▲ x15		▲ x6	
Cappellaro et al. (2020)	▲ x3		▲ ▲	
Arbolino et al. (2020)	▲			
Savini and Giezen (2020)		▲		
Cramer (2020)		▲ ▲	▲ ▲	
Nohra et al. (2020)	▲ x4			
Silvestri et al. (2020)	▲	▲ x3		
Vanhamäki et al. (2020)	▲	▲ ▲	▲ x4	
Alonso-Almeida and Rodríguez-Antón (2020)	▲ x17			
Sánchez Leivoso et al. (2020)			▲ x4	▲ x3
Aranda-Usón et al. (2020)				
Santagata et al. (2020)	▲			
Real et al. (2020)				
Drejerska et al. (2020)				
Bianchi et al. (2020)				
Banias et al. (2020)	▲ x3	▲	▲	
Gardiner R., Hajek P.	▲			
Kokkinos et al. (2020)		▲		
Amenta and Qu (2020)				
Patricio et al. (2020)	▲ ▲	▲		
Foschi et al. (2020)	▲ x4	▲ x4		
Cossu et al. (2020)	▲ ▲	▲	▲	
Scarpellini et al. (2019)	▲ x4			
Bezama et al. (2019)	▲ ▲	▲ ▲		
Agovino et al. (2019)	▲ x4			
Paletta et al. (2019)	▲ x10	▲		
Savini (2019)		▲ x5	▲	▲ x3
Virtanen et al. (2019)	▲	▲ x3	▲	
Alaerts et al. (2019)	▲ ▲			
Obersteg et al. (2019)	▲	▲ x3	▲	
Dąbrowski et al. (2019)				
Van den Berghe and Vos (2019)	▲ x9	▲ x6		▲ x7

Grippo et al. (2019)	▲x4			
Volk et al. (2019)	▲▲			
Gravagnuolo et al. (2019)	▲x6	▲x12	▲x8	▲▲
Avdiushchenko and Zajaç (2019)	▲x8	▲x7	▲x10	
Christis et al. (2019)	▲			
Vanhamaki et al. (2019)	▲x4	▲x10	▲x7	
Mihai and Grozavu (2019)	▲	▲▲		
Avdiushchenko (2018)	▲x11	▲x7	▲x8	
Smol et al. (2018)	▲x3	▲x3	▲▲	
Andretta et al. (2018)	▲x3			
Marra et al. (2018)	▲x3			
Husgafvel et al. (2018)	▲▲			
Husgafvel et al. (2018a)	▲x4	▲		
Whicher et al. (2018)	▲x9		▲x4	
Aranda-Usón et al. (2018)	▲x5	▲▲		
Barbero and Pallaro (2018)	▲x4			
Patricio et al. (2018)				
Sastre et al. (2018)	▲x5	▲		
Arbolino et al. (2018)	▲▲			
Lombardi (2017)	▲x12			
Taddeo et al. (2017)			▲x10	
Banaite and Tamošiuniene (2016)	▲x5			
Taddeo (2016)		▲	▲x9	
Daddi et al. (2016)	▲	▲	▲x4	
Iacondini et al. (2015)	▲x3	▲▲	▲x3	
Tessitore et al. (2015)		▲	▲▲	
Cutaia et al. (2015)	▲			
Zhu and Ruth (2014)		▲x3		
Mirata and Emtairah (2005)				
Mirata (2004)				
Brand and De Bruijn (1999)	▲			

Table 16: Distribution of different policy levels in the final dataset

2.5.5 Top-down and bottom-up approaches to regional circular economy implementation

Implementing CE at a large scale requires a hybrid approach that is impelled both from the top-down public institutions interventions and bottom-up industry activities (Vanhamäki et al., 2021; Poponi et al., 2020; Sánchez Levoso et al., 2020). The top-down initiatives are the ones stimulated by institutions and linked with strategy and policy decisions, like environmental regulations or economic incentives. Bottom-up interventions are emerging from social movements and business initiatives, such as community-led digital platforms or sharing economy initiatives (Prendeville et al., 2016). Vanhamäki et al., (2021) are further adding that the bottom-up process is comprised of administration and academia, development organisations or associations and the private sector; highlighting the participatory nature.

The policies and legal frameworks stimulating CE are differing cross the world (McDowall, 2017), conditional on the political system and governance structure (Cramer, 2020). China on one hand is promoting the CE as a top-down national political objective, while, on the other hand, Japan, the USA, and EU countries are more reliant on devising bottom-up environmental and waste management policies (Vanhamäki et al., 2021; Ghisellini et al., 2016). Similarly, Gravagnuolo et al. (2019) label the Chinese and European cities as leaders in the delineation and application of the circular city concept. However, the difference between their approaches is evident. The strategies of the Chinese cities are instigated by top-down national policies, while those of the European cities take a bottom-up, place-based stance, adopting diverse approaches depending on their resources and local challenges. More importantly, the strategic action plans for CE transition of many European cities/city-regions are devised with the participation of consultants and local stakeholders (businesses and civil society organisations).

Vanhamaki et al. (2019) highlight the example of the regional strategy of Nitra in Slovakia, where the key stakeholder presented a unique instrument, named 'LEADER NSK'. This instrument has the goal of initiating local actions with a bottom-up approach by allocating support for small local projects. The financed activities include collection points for separated waste in several municipalities and an educational project in a youth educational centre. Agovino et al. (2019) argue that effective waste management practices are highly reliant on the citizen's efforts, though the local government also has an important part to play. Specifically, they brought the example of the bottom-up reaction to the waste crisis in Campania region, where the economic conditions were considerably poor, but the institutional arrangements were effective, and a high cultural engagement was noted. The considerable cultural commitment did not only motivate individuals to develop intrinsic pro-environmental values, but more importantly contributed to extending the social network which strengthened the engagement through peer pressure (Bilz and Nadler, 2014). Amenta and Qu (2020), in their work concentrated on spatial design for contemporary, resilient, and regenerative regions, refer to experiments carried out in a design studio in Naples. The emphasis was on revitalising wastescapes, as an underlying premise of holistic adaptation strategies for resilient and circular regions. The foreseen actions were based on a co-design process, commencing from bottom-up actions conceived locally with the partaking of the local

community. The bottom-up initiative in the Dutch Mid-Brabant Region from 2018, was built around the 'makerspace notion: common facilities where innovations are prototyped, tested, and advanced into commercial goods of production technologies. These bodies, organised as associations, are working closely with diverse group of actors from the academia, industry and local governments, and the CE focus areas are textiles, construction, manufacturing/smart industries, and food (Cramer, 2020).

Sánchez Levoso et al., (2020) are proposing a methodological framework to enable better understanding and application of CE strategies in urban systems, single city, or urban regions. Their framework is inclined towards the top-down strategies, while the close collaboration with stakeholders is also emphasised. The wider stakeholder's participation implies recognition of the bottom-up efforts, which is aligned with the belief that policymakers should be instrumental in the promotion of bottom-up initiatives (Bergman et al., 2010). The detection of opportunities for circular activities depends on the local characteristics, therefore, it is vital local actors that have developed deep understanding and knowledge of it are involved in the debate (Sánchez Levoso et al., 2020).

Paletta et al. (2019) focused on the barriers and challenges to plastics valorisation in the European CE context. They stress the inability of the present approach to meet the projected recycling target of 55% by 2025 without bottom-up support from industry and the community (Winans et al., 2017). They suggest a radical transformation of the complex value chain of plastics, which includes integrative collaboration; innovative solutions; and significant efforts by key decision-makers, industry (plastics waste sorters, recyclers, retailers), and consumers. Sánchez Levoso et al. (2020), Vanhamäki et al. (2020) and Aranda-Usón et al. (2018) call for a balanced approach, combining both bottom-up and top-down initiatives, and the equal commitment of all stakeholders. The transition towards a CE requires both the support of the government via top-down policy instruments (e.g. subsidies and tax incentives) and encouragement from the bottom in response to changing social preferences (Vanhamäki et al., 2020; EOI, 2016). The foundation of the policies should be on flexible and innovative governance model able to consider new structures of rules and actors capable of combining top-down and bottom-up processes (Nohra et al., 2020).

The potential role of supporting structures, also named intermediaries is brought up in the literature, as a way to cultivate connections at different territorial scales with the purpose of having both top-down approach (commencing from regional to local policies) and bottom-up approach (commencing from local users and consumers) (Real et al., 2020). In that context, Cramer (2020) is exploring which function transition brokers, as systemic intermediaries, can undertake for the regional governance of implementing CE, while Poponi et al. (2020) are investigating the role of academic Spin-Offs, as science-based companies, to facilitate the transition from the linear to circular economy.

The top-down and bottom-up approaches have been also used in the context of the wider EU policymaking, including the different spatial levels of governance, i.e., EU, national, regional, and local (Henrysson and Nuur, 2021; Ortega Alvarado et al., 2021; Stanojev and Gustafsson, 2021; Sutcliffe and Ortega Alvarado, 2021; Alonso-Almeida and Rodríguez-Antón, 2020; Nohra et al., 2020). Stanojev and Gustafsson (2021) draw the attention to the significance of the bottom-up policy approaches in respect of smart specialisation (S3) as an instrument for CE and cultural heritage since it entails a participatory activity on wider spatial-territorial resources. The recent work of Vanhamäki et al., (2021) exploring the spatial adoption of the CE via conceptual framework of research and innovation strategies for S3 in the EU is fundamental in this discussion. The multi-country contrast of S3 in 12 EU regions that have identified the CE as a priority area revealed that all regions have followed a bottom-up approach to define their regional CE roadmaps. In addition to that, three regions stated they also followed a top-down approach in combination with the followed one, hence a balanced or hybrid approach.

The importance of stakeholder engagement for the creation of a shared bottom-up policy design has been reported in a recent study (Nohra et al. 2020). The engagement process occurred via system design, where the actors were encouraged to overcome the silo mentality and rift between areas and functions, but rather focus on shared goals. It is important to mention though, that commitment in the policy design process does not ensure same engagement in the policy realisation according to research findings (Nohra et al., 2020). The bottom-up approach to decision-making and policy development has also emerged as significant policy enabler by local actors, regarding its usability and feasibility (Kaya et al., 2021).

Alonso-Almeida and Rodríguez-Antón (2020) are characterising as a top-down transformation the general approach EU is adopting to deploy legal instruments, i.e. directives, policies and recommendations, implying initially national regulations are adjusted and then lower regulations which are impacted. Other studies are focusing on the roles of counties and municipalities in the design of policies in Nordic countries (Ortega Alvarado et al., 2021; Kommunal-og moderniseringsdepartementet, 2020; Lidström, 2018; Sjöblom, 2018). More specifically, in Finland from 1990s a rearrangement of authority from national to sub-national levels to improve their decision-making abilities has happened (Sjöblom, 2018). In Sweden, it was observed that top-down influence from the EU has incited sub-national levels to intervene this influence in the Swedish state (Lidström, 2018). In Norway, the subnational authorities are functioning within the national laws and regulations. Nevertheless, they are self-governed, implying they need to govern in accordance with their local settings, but within national guidelines (Kommunal-og moderniseringsdepartementet, 2020).

On the other hand, Sutcliffe and Ortega Alvarado (2021) are acknowledging the protagonist role of the subnational authorities in EU policy and regulative implementation (Borghetto and Franchino, 2010), but claim that adaptations of the EU policies to national policies is happening following a top-down approach, though they are locally adjusted (Alasuutari, 2015). Therefore, the concept of policy diffusion is inadequate, and the role of locality and cultural context in implementing global policies could be explored through the mechanisms of the domestication framework (Sutcliffe and Ortega Alvarado, 2021). The spatially centric nature of the systemic change entailed by the CE adoption requires more profound understanding of place-specific bottom-up route formation (Henrysson and Nuur, 2021). However, the authors are portraying the CE as a top-down transformational approach within the regional development context of the natural resource-based sector, and they point to the need for research in terms actor-centred interventions design to target key actors of change which have been overlooked (Henrysson and Nuur, 2021).

In their seminal work from 1999, Brand and De Bruijn are introducing the concept of shared responsibility, as one of the key principles emerging from the Fifth Environmental Action Programme. According to them, collaboration is one of the routes to sustainability, because none of the concerned actors (governments, industry, NGOs, or the general public) had the individual capability to generate the changes required for ecological modernisation. Many

different formats of collaboration exist, though they are proposing the Industrial Ecology (IE) format at industrial estates. Their conclusion from over two decades ago is that the creation of sustainable industrial estates should not be over-planned, and space for flexibility and innovative approaches shall be left (Brand and De Bruijn, 1999).

Eco-Industrial Parks (EIPs), an underlying premise of the CE, have different ways of formation. They can be created as an outcome of a bottom-up initiatives of companies, aiming to improve their performance, cut costs, increase profit, via exchange of resources. Conversely, the formation of an EIP can be a result of a planned top-down approach directed from institutions and bodies of local government, research centres, or universities (Taddeo, 2016). The former approach has proved as being more prosperous in terms of growth and progress over time (Gibbs and Deutz, 2007), but also with regard to resilience, strength, and ability to adjust to market dynamics (Chertow and Lifset, 2008).

Another concept is the Ecologically Equipped Industrial Area (EEIA), introduced in 1998 by a national law in Italy, as the most important model for the sustainable local industrial development. For the EIPs, the legislative nature of the EEIA model, excessive planning, bureaucracy, and inflexibility of the top-down approach proved to be a disincentive for both regions and companies, particularly the attainment of regulatory targets concerning the environmental performance (Taddeo, 2016). Tuscany, one of the most engaged Italian regions with Industrial Ecology (IE) approach as a policy tool, introduced in 2009 the Tuscan Regulation 74/2009 and Resolution 1245/2009 to launch the scheme and criteria to avail EIPs to voluntarily achieve the EEIA certification. This certification standard, entirely controlled at the regional level, is the first adoption of EU environmental and industrial policies of a voluntary policy tool intended to promote the formation and spreading of EIPs. The Tuscan example has been emphasised as an innovator combining holistic approach based on voluntary co-operation, bottom-up policy making and third-party certification schemes (Daddi et al., 2016).

The establishment of Industrial Symbiosis (IS), which is the pillar of CE, has also been a subject of research. Namely, three main modes of formation have been identified, self-organisation, facilitation by organisations or individuals, and top-down planning (Patricio et al., 2018). It has been reported that self-organised IS networks have greater chances of success compared

to the top-down planned strategy, implying that the bottom-up initiatives are more effective when it comes to IS connections (Chertow and Ehrenfeld, 2012; Costa et al., 2010).

Taddeo et al., (2017) went a step further, and have studied if Innovation Poles (IPs) can promote the establishment and expansion of IS. IPs are defined as a government-sponsored consortia founded within EU programmes with the goal to incite innovation within networks of organisations and promote competitiveness in a sector or a value-chain at local or regional levels. Moreover, they are created as planned consortia, emerging from a top-down initiative where the local authorities have significant function for decision making and identification of technological and territorial targets. Nevertheless, this presence of local authorities and bureaucracy can have a negative impact on crucial factors for the development of long-lasting IS projects, such as trust, motivation, and proactive and cooperative atmosphere. Considering this, Taddeo et al., (2017) are suggesting an approach where the IP governance body is having a facilitating role (assisted by universities and research centres), stimulating initiatives, and raising awareness that IS can be a source of competitive advantage and growth for the whole region.

2.5.6 Drivers and barriers in relation to regional circular economy implementation

Most of the papers tackle the issue of drivers and barriers in relation to CE implementation (Sani et al., 2021; Nohra et al., 2020; Dabrowski et al., 2019; Obersteg et al., 2019; Paletta et al., 2019; Lombardi, 2017). **Table 17** summarises the relevant studies on specific drivers of CE implementation, as well as barriers and challenges to the introduction and transition. Several studies suggest incentives for overcoming these deterrents. It is evident that most papers identify barriers and challenges, and some of the most frequently cited are lack of policies, regulations, funding, and awareness. Policies and funding instruments are among the most commonly identified drivers. It is important to note that CE implementation differs in each region or city, depending on geographic, environmental, economic, and social factors. Therefore, each region must consider the region-specific processes affected by CE, as well as taking into account the barriers and challenges (Avdiuschchenko, 2018). According to Compagnoni (2020) the regional authorities have fundamental role in developing policies for CE transition, because local driving forces and challenges linked with CE are very specific.

For example, agricultural regions can concentrate on diffusing bioeconomy practices, the urban territories can focus on practices like “product as a service” while manufacturing regions on facilitating product innovation via eco-design. In their proposed methodological framework for developing regional CE roadmaps, Sanchez Levoso et al. (2020) argue that potential barriers for implementing CE practices shall be analysed and included in the final roadmap, as well as solutions for overcoming them.

Despite the endorsement of the CE paradigm by the EU, the actual adoption is restricted, mainly due to cultural barriers (Kirchherr et al., 2018), though De Jesus and Mendonça (2018) claim “harder” obstacles are also hampering the transition towards the CE because even when CE practices are viable technically, there are still economic and market restraints (Sanchez Levoso et al., 2020).

Henrysson and Nuur (2021) state the institutional environment can be found on both sides, as a driver and a barrier for the CE transition, and institutional factors are main driving forces for outlining potential pathways for transformation. Moreover, they postulate three determinants for endogenous and directed shift towards the CE in the regional context: proximity of knowledge of physical flows and material assets, maturation and diversity of market networks and inherent values and patterns of cooperation. As claimed in their study *“emerging regional industrial CE practices are shaped by systems and networks of markets defined by inherent values and modes of cooperation that depend on the interplay between institutional and material circumstances, technology, and spatial industrial dynamics”*.

Alonso-Almeida and Rodríguez-Antón (2020) explored the role of institutional pressures in the diffusion and application of CE from the central government to the regions. The findings showed coercive pressures are the most effective ones for advancing the CE in the Spanish regions, though normative pressures are not so relevant. Nevertheless, suggestions to reinforce some coercive instruments were made, in the shape of laws, sanctions or support for adopting CE practices. Mimetic pressures also appeared as relevant for the CE transition in the Spanish regions, probably attributable to the selection of performance or proximity traits.

Study	Drivers	Barrier/Challenge
Henrysson and Nuur (2021) <i>Enabling and constraining factor in the CE transition</i>	-Institutional environment	-Institutional environment
Kaya et al. (2021) <i>Multi-level policy enablers that accelerate and facilitate adaptive reuse practices in the transition toward CE</i>	1.European (EU Funding and Grants EU Directives, support coming from Development Banks, EU Action Plan for the CE, pact of Amsterdam, Historic Urban Landscape approach) 2.National (bottom-up approach to policy development, national subsidies and market-based incentives, national public funding and special budget, policies in favour of key national clusters, governmental circular economy, and heritage priorities for smart specialisation) 3.Local (awareness raising campaign and education tools, multi-stakeholder platforms and citizen engagement, support for the development of sustainable tourism and mobility plans, environmental impact assessments and risk mitigation plans, scaling up public procurement for adaptive reuse, enhancement of policy communication and enforcement, flexible land use regulations)	
Lechner et al. (2021) <i>Driving force for CE</i>	-Repair	
Sani et al. (2021)	-Administrative and tributary simplification for the green companies	-Costs related to adaptation to process/products -Conflict with other investments propriety

<p><i>Stimuli that incentivise green and non-green companies to invest in the green economy in Emilia Romagna region</i></p> <p><i>Internal obstacles for making investment in the green economy in Emilia Romagna region</i></p>	<ul style="list-style-type: none"> -Contributions from public bodies -Consumers/customer demands -Normative clarity -Qualified human resources existence -Infrastructure donation -Green suppliers presence -Green purchasing from public bodies -Better collaboration between companies 	<ul style="list-style-type: none"> -Difficulty to find consumer sensitive to the subject -Increasement of operational costs -Low profitability -Difficulty to participate in public funding calls -Other costs related to R&D -Lack of strategic plan about the subject -Lack of internal competencies in companies -Lack of skilled labour force -Lack of companies' commitment -Lack of green suppliers
<p>Sutcliffe and Ortega Alvarado (2021)</p> <p><i>Identified barriers by the government which impair the CE transition</i></p>		<ul style="list-style-type: none"> -Regulatory -Legislative
<p>Alonso-Almeida and Rodríguez-Antón (2020)</p> <p><i>Institutional pressures as drivers for CE implementation at the regional level</i></p>	<ul style="list-style-type: none"> -Coercive pressure (exerted by laws and based on a system of rules, sanctions, and rewards) -Normative pressure (promoted by regulations, recommendations, and rules provided to reach certain goal) -Mimetic pressure (exerted by imitating behaviour that others have perceived as similar) 	
<p>Cramer (2020)</p> <p><i>National governments can enhance CE through</i></p>	<ul style="list-style-type: none"> -Short- and long-term objectives and policy instruments (subsidies, tax incentives, regulatory instruments) 	
<p>Nohra et al. (2020)</p> <p><i>Main barriers to CE implementation</i></p>		<ul style="list-style-type: none"> -Cultural (current value and norms, current social practices, cultural diversity, public unawareness of resource cycle, public unawareness with natural environment, current lifestyles) -Economic (economic viability, prospective resource value is uncertainty, need of financial incentive, financial risk, global

		<p>supply chain, cost of dealing with pollution, high land value and isolation of low-value activities, restricted demand for looped sources, health and safety risks, low price of raw material, absence of public expenditure and dependence on private expense)</p> <p>-Information (deficiency data availability, lack quality of data, deficiency of information, loss of trust in information transfer and collect)</p> <p>-Regulatory (absence of supportive framework, emerging models for looped resources, need of multilevel regulatory framework)</p> <p>-Political (neoliberalism, require for long-term political support, clashing priorities, absence of combined approach to policymaking)</p> <p>-Institutional (fragmented government, cultural and structural inertia, absence of cross-sector alliance, separate performance of services, private actor appointment, absence of institutional capability, managing authorities with limited controls/capabilities/resources, absence of autonomy amongst local stakeholder, absence of commitment with civil society, absence of trust in policymakers)</p> <p>-Technological (absence of dissemination on circular planning and design methods, technical limitations, absence of operational conditions, modelling resource flows, current linear resource flows)</p> <p>-Environmental (pollution of environment, long-period to renew ecosystems, depraved urban resources)</p>
Patricio et al. (2020)		-Lack of sufficiently detailed data on the available industrial waste
<i>Hampering implementation of CE and IS</i>		
Poconi et al. (2020)	-Academic spin off enterprises	

<i>Driver for development of circular business models and facilitate the CE transition</i>		
Sanchez Levoso et al. (2020)	-Urban areas as hubs for innovation, economic activity, and growth	
<i>Drivers in the global transition towards CE</i>		
Silvestri et al. (2020)	-Developing a strategic vision of a region	
<i>Major driver for fostering regional CE</i>		
Andretta et al. (2019)	-Taxation of waste production or dumping, or of other environmental issues -Bans disincentives	
<i>Environmental taxes to promote the EU CE strategy</i>		
Bezama et al. (2019)		-Resources: The establishment of sustainable regional feedstock strategies and supplies for supporting the bio-industrial sector -Collaborators: The establishment of a regional “critical mass” by fostering supply chain clusters and networks -Neighbours: Understanding the local dynamics of societal trends and preferences and social acceptance of biotechnologies and their representative bio-based products
<i>Three-pronged challenges in the implementation of bioeconomy regions</i>		
Scarpellini et al. (2019)	-Subsidies and bonuses to promote the CE in business -Awareness raising campaigns to promote the CE -Creation of a regional waste-interchange systems -Dissemination of good practices and green procurement -Certification of products and/or companies -Subsidised training plans for employees	-Lack of funding for the investments -Price increase not appreciated by consumers -Lack of standards for actions -Difficulties supplying recycled products -Lack of interest from shareholders and stakeholders -Lack of trained specialised personnel Additional barriers (regulatory and administrative, lack of stable regulatory framework that favours long-term investments required by the CE, difficulties to achieve volume and standards
<i>CE drivers and barriers at a regional level</i>		

		requirements for recycling materials, end of pipe principle (product design), resistance to change)
Savini (2019) <i>Logistics sector as a target and driver for CE policymaking</i>	-Social -Economic -Political	
Tura et al. (2019) in Sani et al. (2021) <i>Main obstacles to an effective transition</i>		-Political and institutional barriers
Aranda-Uson et al. (2018) <i>Favourable conditions that can accelerate the transition towards circular models</i> <i>Challenges to improve the introduction of CE in China</i>	-Regulation and public support -Geographic proximity -Local and regional authorities, policymakers -Facilitation of the introduction of industry-driven and/or collaborative models (self-regulation) -Establishment of voluntary standards -Promotion of eco-design and manufacturing standards that stimulate closing of materials loops -Need for both bottom-up and top-down approach and involvement of all stakeholders (private firms, government, and society)	-Lack of reliable information -Shortage of advanced technology -Poor enforceability of legislation -Weak economic incentives -Poor leadership and management -Lack of public awareness
Avdiuschchenko (2018)	-Circular cities as main drivers on the road to CE model implementation in their surrounding regions -CE-related policies that can balance the numerous benefits of the CE model with the need to decrease transactional costs	-Lack of CE monitoring instruments for EU regions create barriers to CE policy's effective implementation -Transactional cost (economic/social) some industries are facing -Informational barriers and lack of CE awareness among various stakeholder groups -Economic/financial/ market barriers related to lack of financial support for activities related to CE transition -Institutional/ regulatory/policy -Technical/ Technological

<p>Barbero and Pallaro (2018)</p> <p><i>Transition to a CE model hindered by various barriers</i></p>	<ul style="list-style-type: none"> -The need of policies to support a CE -System Design can support the transition to a CE 	<ul style="list-style-type: none"> -Economic (market failure, unaccounted externalities) -Social (lack of experience to identify opportunities) -Regulatory (regulations that hinder exchange of waste)
<p>De Jesus and Mendonca (2018) in Sani et al. (2021)</p> <p><i>Barriers to transition towards a CE</i></p>		<ul style="list-style-type: none"> -Harder factors (Technical related barriers: inappropriate technology, the lag between design and diffusion, lack of technical support and training; economic/financial/market related barriers: large capital requirements, significant transaction costs, high initial costs, asymmetric information, uncertain return, and profit) -Softer factors (institutional/regulatory/social/cultural: misaligned incentives, lacking a conducive legal system, deficient institutional framework, rigidity of consumer behaviours and businesses routines)
<p>Kirchherr et al. (2018), Ritzen and Sandstrom (2017) in Sani et al. (2021)</p> <p><i>Barriers to transition towards a CE</i></p>		<ul style="list-style-type: none"> -Cultural Lacking (consumer interest and awareness, hesitant company culture, operating in a linear system, limited willingness to collaborate in the value chain) -Attitudinal (sustainability perception, risk aversion) -Market (low virgin material prices, high upfront investment costs, limited funding for circular business models, limited standardisation) -Regulatory (obstructing laws and regulations, lack of global consensus, limited circular procurement) -Technological (narrow circular design, too few large-scale demonstration projects, lack of data (e.g., on impacts), ability to deliver a high-quality remanufactured product) -Financial (measurement of financial benefits of CE, financial profitability) -Structural (lack of exchange of information, unclear distribution of responsibilities) -Operational (infrastructure management/supply chain)

Smol et al. (2018)	-Financial support by national and regional governments	-Raising awareness among the region's inhabitants (society is open to transition but it takes time to change people's way of thinking and acting)
<i>Crucial challenges for the implementation of CE assumptions in everyday life</i>	-Educational materials and activities to shape the attitudes of consumers	

Table 17: Drivers and barriers – related to CE development/implementation

While some studies identify generic drivers and barriers in relation to CE introduction, development, and implementation, a substantial proportion focus on specific sectors (e.g., forest, waste, design, plastics), or practices related to waste management, IS, IE. Additionally, Obersteg et al. (2019) apply the PESTEL-O framework to identify governance challenges for urban regions shifting to CE. Furthermore, the pioneering work of Dabrowski et al. (2019) sought to understand and overcome the barriers to knowledge transfer in the field of CE. For this purpose, the paper adopts novel empirical material: namely, the knowledge transfer process on spatial solutions for encouraging CE between two EU metropolitan regions (the Amsterdam metropolitan area and the Naples metropolitan areas), focusing on eco-innovative solutions for circular resource management. The recapped version of these specific attempts, with the very granular and sector-specific barriers and drivers, is presented in **Table 18**.

Study	Drivers	Barrier/Challenge
Yu et al. (2021)	-Technical -Political -Economic (benefits) -Informational -Organisational	-Lack of successful CE business models which guarantee the economic benefit for all actors
<i>Factors influencing the IS initiation</i> <i>Barriers against CE adoption in construction supply chain</i>		

Agovino et al. (2020)	-Awareness-raising campaigns -Regulatory instruments -Monetary rewards -Voluntary agreements
<i>Policy instruments to incentivise citizens to separate waste</i>	
Real et al. (2020)	-Convivial technologies (level of automatisisation, open and eco-design, mutualisation platforms) -Social dimensions (worker conditions, participative management, empowerment in sustainable behaviours) -Regional policies (extended responsibility for all stakeholders, access to abandoned and local places, local and transparent governance) -Textile intermediary organisations (resources and knowledge, emergence and synergies, immersive cooperatives)
Agovino et al. (2019)	1.Quality of local institutions 2.Extrinsic motivations (those related to incentivise rather than commitment and altruism)
<i>1.Main driver of separate waste collection</i>	
<i>2.Drivers for achievements for separate waste collection in Veneto region</i>	
Obersteg et al. (2019)	(PESTEL-O framework) -Policy/politics -Economic/financial -Social/Behavioural -Technological/infrastructure -Environmental -Legal -Organisational
<i>Governance challenges for urban regions shifting to CE</i>	
Paletta et al. (2019)	-Technical-technological -Legislative

<i>Plastic valorisation</i>		<ul style="list-style-type: none"> -Economic -Socio-cultural
Dabrowski et al. (2019) <i>Knowledge transfer process on spatial solutions for promoting CE, focusing on eco-innovative solutions for circular resource management</i>		<ul style="list-style-type: none"> -Language -Disciplinary background -Geography (of metabolic flows) -Socio-cultural -Socio-economic differences -Other socio-political phenomena -Legal aspects -Governance and decision-making -Technological aspects
Virtanen et al. (2019) <i>Challenges of closing the loop of regional material flows</i>		<ul style="list-style-type: none"> -SMEs lack resources -Incomplete value chain
Volk et al. (2019) <i>Construction and Demolition (C&D) waste management</i>	<ul style="list-style-type: none"> -Financial incentives -Education -Interlocking policy system 	<ul style="list-style-type: none"> -Regulatory and incentive environment -Lack of waste processing facilities -Poor communication among involved parties -Poor awareness and behaviour of project stakeholders -Lack of awareness of environmental implications of waste disposal -Cultural resistance and poor project processes
Vanhamaki et al. (2019) <i>Waste</i>	Waste (biowaste) management	
Husgafvel et al. (2018) <i>Forest sector 1.Barriers in the wood working industry field, potential for cascading recovered solid wood</i>	<ul style="list-style-type: none"> - Technological innovativeness - Supportive regulatory environment - Extended Producer Responsibility (EPR) schemes could be one option to promote the recovery and use of wood in new products and also to help direct more attention to design processes that would ease the dismantling of products. 	1. Scale and profitability (processes optimised for logs, strength grading in load bearing structures, possible humidity requirement, quality requirements, moisture content, origin of the recovered wood, cleanliness, humidity requirements in bendings, availability of recovered hardwoods, sorting, energy use) 2. Price/cost effectiveness (industrial scale, quality, cleanliness, logistics, availability, requirement for moisture, origin,

2. Barriers in the use of recovered wood		authorisation, strength grading, separation of wood species, length, appearance)
Husgafvel et al. (2018)		<ul style="list-style-type: none"> -Clever products and services -Development of cooperation -Energy efficiency -Evaluating the developing of supply/value chain -Creating value added -Increase of sectoral cooperation and interaction -Increasing of recycling and reuse -Intelligent production and processes -Local or regional resource banks -Material efficiency -Minimising waste -New symbiosis products -Utilisation of by-products and side flows -Developing of international guidelines and best practices -Development of harbours operation and management -Development of logistics -Development of operational environment of EU -International vocational education
Challenging areas of CE in the seafaring sector		
Patricio et al. (2018)	<p>1.Avoid/reduce disposal costs (new business opportunity, marketing reasons, reduce cost for virgin materials, avoid/reduce disposal cost, improve environmental performance, marketing reasons, new business opportunity)</p> <p>2.Avoid/reduce disposal costs (reduce load on their own sewage system, improve environmental performance, marketing reasons, avoid/reduce disposal costs, marketing reasons, improve environmental performance)</p>	<ul style="list-style-type: none"> -Difficult to find a receiver -Investing in installing new equipment -Lack of knowledge -Practical issues (storing, transportation) -No economic benefit in participating in a symbiosis -Time limitations, (they need to focus on their core business) -Trust in new partnerships -Lack of knowledge
1.Motivations of SMEs for current IS		
2.Motivations of SMEs to be part of an IS		
Barriers for by-product sharing in an IS		
Sastre et al. (2018)	-Recycling targets for municipal solid waste included in EU WFD	

<i>Driver for sustainable waste management in the EU</i>		
Whicher et al. (2018)		-Legislative barriers
<i>Design</i>		
<p>Lombardi et al. (2017)</p> <p><i>1. Selected group of non-technical barriers for the CE through industrial symbiosis</i></p> <p><i>2. Challenges associated with implementing industrial symbiosis from the survey results</i></p>	<p>Benefits of industrial symbiosis implementation from the survey results:</p> <ul style="list-style-type: none"> -Improved environmental performance of the company -Reduced costs of waste disposal -Improved environmental performance of the community -Revenue generation -Adherence to regulatory requirements -Satisfaction of CSR requirements -Reduced cost of input -Opportunity to implement similar process in other areas of business -Improved links with other businesses -Improved quality of inputs 	<p>1. Informational (regulatory and policy, commercial, organisational/governance)</p> <p>2. Process barriers (regulatory barriers, financial barriers, transport barriers, lack of information regarding alternative feedstock/inputs, lack of time to implement solutions, long timeframe for implementation of solution, coordination barriers, concerns about confidentiality, gaining approval from relevant authorities, contractual barriers, logistical barriers)</p>
<p>Taddeo (2016)</p> <p><i>Main factors for development and diffusion of EEIAs models</i></p> <p><i>Main limits for diffusion of EEIAs models</i></p>	<ul style="list-style-type: none"> -Presence of centralised management -Shared infrastructures and services -Administrative simplifications with regulations 	<ul style="list-style-type: none"> -Amount and long-time of return of the initial investment -Risks that EEIA would run if key elements of the system were missing -Regulatory limits -Legislative nature of EEIA model (excessive planning, bureaucracy and inflexibility of to-down approach can be disincentive for both the regions and companies)
<p>Iacondini et al. (2015)</p> <p><i>Difficulties to make a technology transfer of technically applicable processes in Italy</i></p>		<ul style="list-style-type: none"> -Inadequate regulatory framework -Lack of collaboration between different companies and supply chains -Resistance to share sensitive data about internal waste fluxes -Lack or wrong communication towards companies and lack of a coach/leader authority -Economic convenience

Brand and De Bruijn (1999)	-Technical
<i>Barriers for establishing IE approach</i>	-Informational
	-Economic
	-Regulatory
	-Motivational

Table 18: Drivers and barriers – in specific sectors/fields

2.5.7 Mechanisms for regional circular economy implementation

2.5.7.1 Policy mechanisms for regional circular economy implementation

A more ample and overarching comprehension of the CE mechanisms is vital for better integration of the CE paradigm within national and regional policies (Vanhamaki et al., 2019). **Table 19** summarises the policy mechanisms and measures for CE implementation proposed in the literature. The work of Aranda-Usón et al. (2018) is pivotal in this regard, where the authors suggest several measures policymakers can introduce to support the CE transition, such as the *‘introduction of industry-driven and/or collaborative models (for instance, ‘self-regulation’); the establishment of voluntary standards, especially concerning the management and valorisation of resources; and, the promotion of eco-design and manufacturing standards that stimulate the closing of materials loops.* Towa et al., (2021a) calls for a cohesive approach for all CE interventions, taking into regard inputs of resources, outputs of waste and related emissions, therefore ensuring the systemic dynamics are considered and the adoption of any CE practice will not imperil a change of environmental issues.

In this context, regions play a vital role, and policymakers are perceived as drivers of the adoption of CE at the regional level, since they are supporting companies to close their material loops and adopt CE-related practices. Additionally, the regional scale is deemed to be vital for application of waste management policies taking into regard that regions and municipalities are accountable for separate collection systems, as well as founding and overseeing treatment facilities (Gardiner and Hajek, 2020).

Study/Context	Policy mechanisms for CE implementation
<p>Foschi et al. (2021)</p> <p><i>Practical recommendations for plastic waste management measures in ERR (Emilia-Romagna Region) – requiring participative stakeholder’s path</i></p>	<ul style="list-style-type: none"> –Promote various engagements to decrease plastic waste –Raise awareness to advance the performance of collection systems –Apply the deposit-refund system, especially for PET bottles to reduce pollution and boost the profitability of rPET market –Foster eco-design through training activities and financial measures –Synchronise data collection among national and independent consortia –Initiate focus groups discussing the introduction of actions to monitor the flow through Secondary Plastics (SPs) –Support remanufacturers to make high- quality SPs and monitor the performance –Finance new industrial recycling infrastructure
<p>Kaya et al. (2021)</p> <p><i>Relevant policy/instrument that facilitate adaptive reuse practices in the transition towards CE</i></p>	<ul style="list-style-type: none"> -Public procurement -Tourism development plan -Market-based incentives, public subsidies -Public funding, subsidies, financial incentives -EU directives -European Social Fund, European Regional Development Fund; national subsidies -Citizen engagement tools -Community improvement plan -Land use plan, building regulations -Land use plan, environmental impact assessment -Environmental impact assessment -Public procurement -Building regulations and codes, waste management policies -Smart mobility plans and incentives -National grants and subsidies, cultural-focused land use -Participatory governance models and tools -Citizen engagement tools

<p>Lechner et al. (2021)</p> <p>1) <i>Policy instruments for sustainable consumption</i></p> <p>2) <i>Policy incentives to stimulate demand for repair services in EU and USA</i></p> <p>3) <i>Local and national initiatives by the public sector for reuse and repair</i></p>	<p>1.-EU's Eco-design Directive</p> <ul style="list-style-type: none"> - Measures taken against planned obsolescence and in support of spare parts availability (France) -Reduced VAT for selected repair services (Sweden) <p>2.-VAT reductions on repair services and sales of second-hand goods</p> <ul style="list-style-type: none"> -Tax reductions for incentivising repair -Using tax reductions to increase donation of used goods to social enterprises <p>3.-Establishing donation centres for collecting used objects which are then forwarded to repairers (Metropole de Lyon, 2020)</p> <ul style="list-style-type: none"> -Recovery and repair of damaged furniture by homeless people (Urbact, 2017) -Gamification approaches to integrate CE into daily life of residents (Stad Antwerpen, 2020) -Collection and preparation for reuse of used products in interconnected reuse centres by socially disadvantaged workers (CPU Reuse, 2020) -Tax policy for incentivising repair of bicycles, clothes, and white goods in Sweden (Kopple et al., 2019)
<p>Sani et al. (2021)</p> <p><u>1. European regulations related to CE:</u></p> <p><i>Directive (EU) 2018/849, modifies the 2000/53/EC, 2006/66/EC 2012/19/EU</i></p> <p><i>Directive (EU) 2018/850, amends Directive 1999/31/EC</i></p> <p><i>Directive (EU) 2018/85, amends Directive 2008/98/EC</i></p> <p><i>Directive (EU) 2018/852, amends Directive 94/62/EC</i></p> <p><u>2. Italian regulations related to CE</u></p>	<p><u>1. Measures for the European regulations related to CE</u></p> <ul style="list-style-type: none"> -Introduction of a rapid monitoring system for compliance with the objectives -Extended responsibility for producers, with the definition of minimum requirements differentiation of the contribution due based on the costs necessary for the treatment of products at the end of their life -Promotion of prevention (including food waste) and reuse -Regulation of by-products and end-of-waste, which may not be considered as waste as long as they meet certain conditions -Alignment of definitions, calculation methods for objectives, reporting obligations and implementing provisions <p><u>2. Measures for the Italian regulations related to CE</u></p> <ul style="list-style-type: none"> -More straightforward and more understandable legislative framework -Financial incentives for sustainable production and consumption -Communication and information activities to spread culture on the CE -Promotion of research and innovation <p>Introduces the obligation for all Italian public bodies to include Environmental Criteria Minimum (CAM) in their public tenders</p>

<p><i>Towards a Circular Economy model for Italy: Strategic framework and positioning document</i></p> <p><i>Law no. 221 - also introduced in the "Procurement Code" (Legislative Decree 50/2016 amended by Legislative Decree 56/2017)</i></p> <p><u>3.Regional (Emilia-Romagna) regulations related to CE</u></p> <p><i>Regional Law n. 16. Provisions in support of CE, the reduction of urban waste production, reuse of end-of-life goods, separate collection, and amendments to the regional law 19 August 1996 n. 31</i></p> <p><i>Regional Waste Plan 2016</i></p>	<p><u>3.Measures for the regional (Emilia-Romagna) regulations related to CE</u></p> <ul style="list-style-type: none"> -More sustainable waste management -More information to create a new civic awareness -New financial instruments (both for the public administration and for businesses) -Reduction of per capita waste production by 20–25% by 2020 -Waste collection of 73% by 2020 -70% recycling by 2020 (65% of municipal waste by 2030 for the EU) -Landfill less than 5% by 2020 (10% by 2030 for the EU) <p>Activation of a Pay-As-You-Throw system by 2020</p> <ul style="list-style-type: none"> -Activation of public-private partnerships for prevention/recovery of waste in various economic sectors -Opening of incentive fund for virtuous municipalities of 11.5 million Euro per year -Activation of permanent working groups for by-products with the production of an official regional register of by-products (peach stones; kernels of apricot; salt from the salting of the meat; black liquor-waste from the paper production process; green residues of sweet corn; residues of the ceramic industries) in alignment with the national ones -Information and awareness campaigns also through a permanent forum on the CE, aligned with the national one
<p><i>Tazi et al. (2021)</i></p> <p><i>Proposed measures for the Construction & Demolition Waste (C&DW), in the French construction sector to increase circularity and improve value of C&DW streams</i></p>	<ul style="list-style-type: none"> -Better Environmental High-Quality accreditation: new labels for reusing secondary raw materials in certified building or CE projects -IE practices: low quality recycled aggregates from the former C&DW used as backfill, foundation layer for roadworks -Audit and pre-sorting: in the French context, compulsory initial audit to evaluate the C&DW stream before demolishing a building - Bonus-malus-principle as a price adjustment of C&DW landfill in waste facilities: an extra tax to cutback the willingness of C&D facilities to landfill C&DW stream and increase the recyclability. Similarly, to implement an extra tax for natural aggregates. Though, this environmental tax should be applied as an incentive measure rather than a punitive one (used and proved effective in Switzerland, Sweden, and The Netherlands, (Lindhjem et al., 2009)) -Eco-distance-basis model for primary and secondary raw material use: using ecological distance to evaluate to use primary raw materials or secondary (recycled) materials when dispatching construction materials into sites

	<ul style="list-style-type: none"> -Tax exemption and loan facility for recycling facilities: Loan facilities could be such as zero interest rate eco-loans, helping to decrease distances between construction and demolition sites and recycling facilities, reducing production costs of secondary materials generated from C&DW -Restructure public contracts toward CE: contract incentives to insert environmental clause for a better life cycle of projects - Toward integrating product-service system (PSS): re-using and leasing high performance concrete-based products -Reverse logistic and design for disassembly: more circular value chains and closer to closing the loop of materials (Morseletto, 2020)
<p>Towa et al. (2021a)</p> <p><i>Increase circularity, regions can reduce their Circularity Gap through several CE interventions</i></p>	<ul style="list-style-type: none"> -Residual waste management (e.g., substitute incineration and landfill by waste recovery when possible) -Resource efficiency (e.g., use of fewer resources per unit of total output) -Closing supply chains (e.g., reuse, repair, refurbish) -Product lifetime extension (e.g., decrease or delay of waste from previous stocks through the design for longevity and maintenance of durable goods)
<p>Yu et al. (2021)</p> <p><i>Outlook of IS improvement in the Dutch Construction industry, Twente region – IS mechanism for CE</i></p>	<ul style="list-style-type: none"> - Implement strict waste classifications on-site to ensure the waste purity -Establish the information-sharing platform to improve the business communication -Provide subsidies to up-cycling technology innovations and circular business models to enlarge cooperation space
<p>Alonso-Almeida and Rodríguez-Antón (2020)</p> <p><i>Legislative initiatives (drivers) of the CE developed in Spain from 2017-2019</i></p>	<ol style="list-style-type: none"> 1.Production and consumption: food policy and CE, sustainable production, sustainable consumption 2.Waste management: waste management policy, plastics policy, waste management especial policies 3.Secondary raw materials: eco-design, biomass policy 4.Competitiveness and innovation: research, development, and innovation (R&D&I), CE Strategy
<p>Cappellaro et al. (2020)</p> <p><i>Emilia-Romagna region actions and tools connected to waste hierarchy</i></p>	<ul style="list-style-type: none"> -Creation of regional forum on CE (all) -Incentives for prevention (prevention) -Information and education activities on prevention and reuse (prevention/reuse) -Promotion of reuse (preparing for reuse) -Establishment of a permanent coordination group for by-products (prevention for reuse/recycling) -Application of pay-as-you-throw system (system disincentives to waste disposal) (disposal)
Compagnoni (2020)	<ul style="list-style-type: none"> -Research and Innovation Strategies for Smart Specialisation (RIS3 or S3) -Single regional laws (RL) -Regional Waste Management Plans

<i>Key instruments used by Italian regional authorities to introduce the CE</i>	
<p>Cramer (2020)</p> <p><i>Main system-building activities of Dutch local government (provinces and municipalities) in implementing the CE locally</i></p>	<ol style="list-style-type: none"> 1. Policy development <ul style="list-style-type: none"> - Formulate vision, ambition, and strategy on CE - Select key areas to start with, based on a mapping of main resource streams and on the crucial economic sectors of the province 2. Adjustment of policy instruments <ul style="list-style-type: none"> - Bundle institutional, legal, and socio-economic barriers, if possible, remove them and communicate the remaining ones publicly to the national government - Integrate CE in spatial planning - Coordinate CE monitoring at provincial level 3. Policy execution <ul style="list-style-type: none"> - Integrate CE in all relevant policy areas of the province - Implement circular procurement in own organisation 4. Facilitation of innovation and learning networks on CE <ul style="list-style-type: none"> - Stimulate product chain innovation and CE entrepreneurship via funds, challenges, and allocation of funds for living labs - Enhance the creation of knowledge exchange and learning networks on CE - Support educational programmes to train scholars in CE at all educational levels 5. Promotion of employment and new businesses in CE <ul style="list-style-type: none"> - Support initiatives, focused on employment and new businesses in CE - Involve people with a distance to the labour market
<p>Gardiner and Hajek (2020)</p> <p><i>1) Tools to facilitate the CE transition for regions completing the transitional stage of their economic structure</i></p> <p><i>2) Eco-innovation mechanisms</i></p> <p><i>3) Tools to stimulate innovation</i></p>	<ol style="list-style-type: none"> 1. Innovative business models, product/organisational environmental footprint, and green public procurement to encourage demand for green goods and services <ul style="list-style-type: none"> - Wide range of economic instruments, like property and landfill taxes, tourist taxes and fees and product taxes to cover the costs of full-service 2. Policy makers should support introduction of the eco-innovation index /scoreboard at the level of EU regions 3. Market-based solutions: taxes, charges, and deposit-refund systems <ul style="list-style-type: none"> - Information technology along with the incentive-based approach, e.g., remote sensor technology to monitor emissions that will either enforce compliance or levy a tax on pollution, spaced-based satellites that

	can monitor environmental compliance across the regions, technologies that may also improve site selection, waste collection and route optimisation, smart recycling technologies utilising artificial intelligence to identify specific garbage components
Nohra et al. (2020) <i>Policy actions to be implemented and monitored at regional and local level of governance</i>	<ul style="list-style-type: none"> -Policy strategies: promoting multi-governance level initiatives addressing the ERDF or other regional policy instruments to direct regional strategies towards the CE and to increase stakeholder participation in circular businesses -Call for proposals: strengthening of CE-related topics and cross-sectoral scope of projects submitted in response to regional calls (mainly based on the ERDF instruments) -Pilot project implementation: implementing pilot projects within key value chains for the regional CE, often in synergy with other funding instruments -Training and education: training activities aimed to different target groups (students, enterprises, public institutions) to create new knowledge and a cultural background favourable to the CE
Savini and Giezen (2020) <i>Variety of policies within the Amsterdam city-region plan for CE transition</i>	<ul style="list-style-type: none"> -Integrated decentred water and waste infrastructures -Reuse of industrial waste (agricultural, chemical, e-waste) for manufacturing -Promotion of eco-consumerism based on sharing and reuse -Transition to biomass-based energy -Improvement of post-separation facilities to increase recycling rates -Establishment of an industrial synergy between airports, harbours, datacentres -Regulatory reform to allow off-grid housing development and decentred energy systems -Introduction of green procurement rules to reuse building materials for new housing -Promotion of a diffuse social economy of re-manufacturing sustained by a more central role of the third sector and the platform providers
Silvestri et al. (2020) <i>Implementing CE in EU regions</i>	-European structural funds play an important role, but other policies and/or socio-economic features are similarly important
Vanhamäki et al. (2020) <i>Strategic goals in the CE roadmap for the Päijät-Häme region</i>	<ul style="list-style-type: none"> -Closed loops of technical streams to create added value -Towards energy self-sufficiency by applying sustainable transport and energy solutions -Piloting and demonstrating innovative CE solutions -New consumption models and business opportunities -Sustainable business from the bio-CE
Andretta et al. (2019) <i>Implement waste management & support CE</i>	-Market-based instruments (e.g., environmental taxes and charges)

Bezama et al (2019) <i>Regional deployment of bioeconomies to enhance regional innovation</i>	-Establishment of collaborative clusters/networks acting as platforms for exchange of knowledge, supply chain improvements, adaptations, and integration for regional bioeconomies
Mihai and Grozavu (2019) <i>Regional Integrated Waste Management Systems</i>	-New National Waste Management Plan requires Romanian counties (NUTS 2 regions) to update their Regional Waste Management Plans to encompass both urban and rural areas to separate collection schemes, sorting stations, composting plants, transfer stations, and regional sanitary landfills in order to successfully achieve these new EU targets related to CE policies.
Scarpellini et al. (2019) <i>Measures to promote CE at regional level (collected from the literature)</i>	1.Technological: programmes to stimulate changes in industrial fabrication, and green patents, promotion of high technology and clean technology industries 2.Financial: access to adequate financial resources, creation of special funds and financial services for risk sharing, financial advisory services 3.Social: training programmes, disclosure of best practices, and of information regarding environmental, economic, and social impact of adopting CE practices 4.Localisation: homogenous regional legislative framework, regional collaboration programmes
Aranda-Usón et al. (2018) <i>1.Measures adopted by EU MS to support the CE practices</i> <i>2.CE-related policy measures for firms at regional level</i>	1.-Subsidies for eco-design -Public acquisition of products and services that meet CE-based environmental standards -Tax breaks for green technologies -Promotion of recycled or sustainable materials 2.-Production area: eco-design, investment and impacts on the manufacturing costs, introduction of the CE in the value chain, improvement of the resource efficiency in processes, neutral technology promotion of technology and digital solutions -Consumption area and products: prolong life through maintenance, repair and design for durability, design for upgradability and adaptability, improve consumers' green awareness -Waste management area: improve chemical and waste regulation, promotion of the public-private collaboration -Other supports: corporate reporting, best practices and technology transfer, quality of information and data of material flows among the value chain, voluntary standards.
Husgafvel et al. (2018) <i>Most significant public steering measures</i>	-Energy and fuel policy -Support of financing, investments, and innovation -Supportiveness and flexibility of local operational environment and communication and education

Sastre et al. (2018) <i>Regional disparities in compliance with EU recycling targets in Spain</i>	-Enforcement mechanisms, both vertically - cascading downwards, in the implementation of the measures that are included in national waste management plans, to the regions, and horizontally to ensure setting a common ground among all regions
Daddi et al. (2016) <i>Policies adopted to disseminate EIPs</i>	-Direct regulation, i.e., command and control, and economic instruments, especially financial subsidies, tax relief, stronger taxation of transport and fuels as well as limiting end-of-pipe emissions through environmental permits (favoured by governments) -Voluntary tools (adopted predominantly by local authorities)
Cutaia et al. (2015) <i>Regulatory actions to encourage IS</i>	-Landfill bans (driven symbiotic practices, e.g., reuse of organic wastes prohibited from land disposal in Denmark and the Netherlands) -Very high tipping fees for waste disposal (Canada) and climate change levies (UK) driving innovation and by-product reuse practices
Iacondini et al. (2015) <i>IS projects at different levels to spread the CE</i>	-Adequate regulatory framework with detailed technical guidelines to allow companies to create an efficient and safe application of IS, including the end of waste quality protocols
Brand and De Bruijn (1999) <i>Three basic models to influence actors in society which governments can use (to stimulate IE at the regional level)</i>	-Command and control (coercive – applied when the consequences of ‘wrong behaviour’ of the target group are far reaching and very serious, e.g., direct threat to the environment or to public health) -Economic stimulation -Voluntary model (highest degree of freedom for the target group)

Table 19: Policy mechanisms for CE implementation

The work of D'Adamo et al., (2020) shift the focus on the possible trade-offs between bioeconomy sectors, traditional vs. innovative industrial ones, as one of the most urgent challenges in sustainability transitions and circular bioeconomy. In this context, local and regional policies can step in and be more integrated to benefit from the geographical proximity and retain regional strategic assets. For instance, dedicated hubs can be formed in order to exploit the territorial closeness between regions dealing with biomass production and regions with associated processing industrial capacities. According to Lokesh et al. (2018), this arrangement between traditional and innovative sectors will shorten the value chain, boost growth and local employment while lessening environmental impact. This is also in line with the Italian bioeconomy strategy (2017), which advocates for “interconnecting effectively the main bioeconomy sectors, across sustainable value chains (...) by leveraging traditional sectors deeply rooted in the territory, as well as the public and private stakeholders in local communities” (p. 48). In the context of the bioeconomy, Bezama et al. (2019) draw the attention to the establishment of regional bioeconomy platforms as an instrument to detect key regional (but also national and local) players and invoke transparency and trust not only within the network but in the wider society. The critical regional mass (including the relevant stakeholders and funding) will be determined by the platforms, as well as the main technological advances required to conduce the sectoral integrations envisioned in the bioeconomy strategic documents.

In their recent work, Henrysson and Nuur (2021) turn the attention to the Natural Resource-Based Industries (NRBIs) under pressure, as chief player vital for a positive result of the CE model diffusion. NRBIs, industries involved in primary extraction of resources but also engaged in secondary (manufacturing) and tertiary (service) sectors, are demarcated by path-dependencies and lock-ins in conventional technologies, infrastructures, and production approaches, making the transition perplexing. These businesses are frequently situated in lagging regions, which most of the times were fundamental regions in the past but have been adversely affected by “*regional socioeconomic and industrial restructuring due to increasing global competition and rationalisation*”. For this reason, to instigate the transformation of NRBIs, the mechanisms of industrial route development towards more circular models must be comprehended and tackled first (Henrysson and Nuur, 2021).

The work of Scarpellini et al. (2019) is also crucial. This is partially presented in **Table 19**, but the main contribution is its proposal of key measures to be incorporated into regional environmental plans, grouped into scenarios according to the intensity with which the CE practices are introduced within the region (**Figure 25**). The results of the case study suggest that a regional CE action plan should be comprised of the following:

- *'Cross-cutting measures (transversal): economic grants and incentives, promotion of eco-innovation, training for new professionals' skills;*
- *Sectoral measures: particularly those aimed to foment the CE in all business sectors;*
- *Territorial measures: specifically designed at the territorial level; and*
- *Governance measures: indicators, standards, planning, organised markets.*

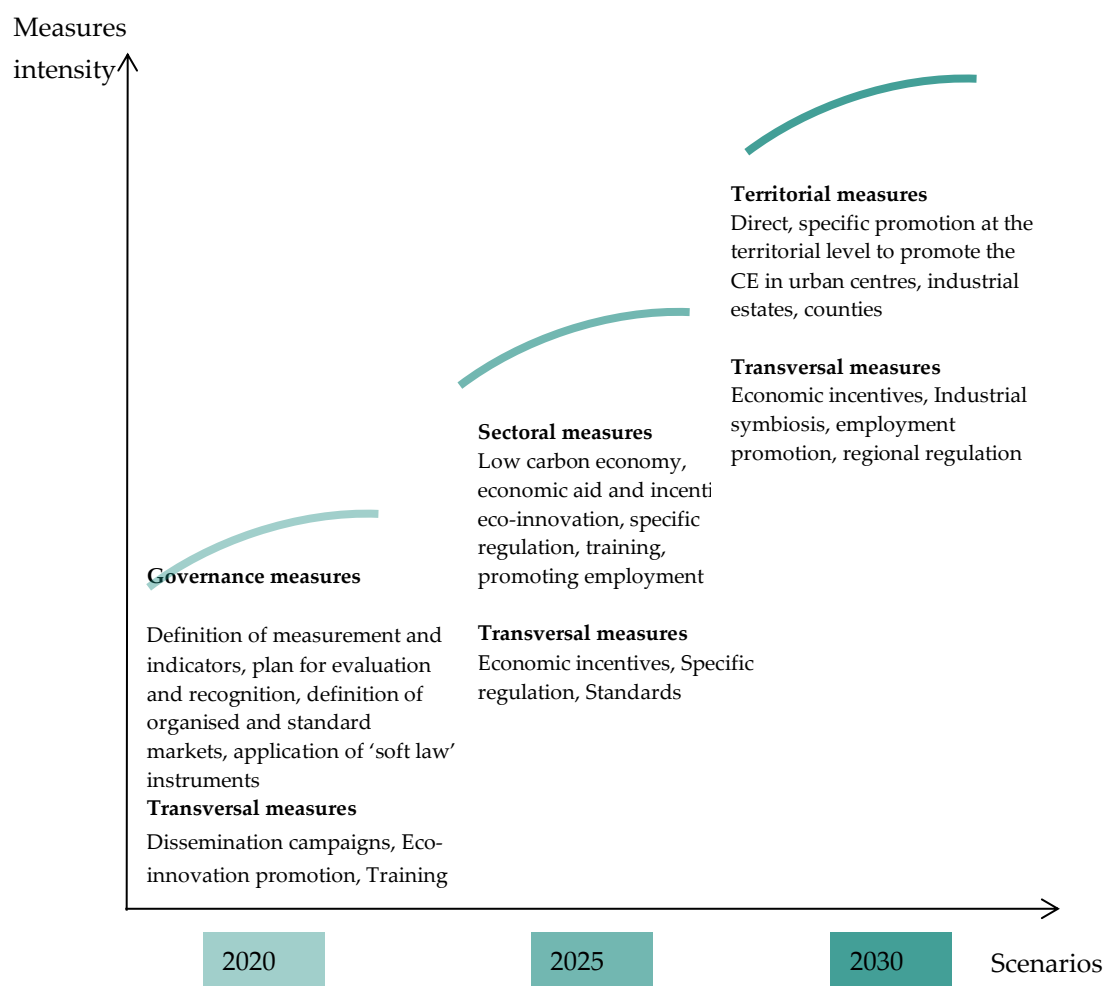


Figure 25: Main measures to be included in the environmental regional plans for different scenarios depending on the intensity of the level of CE adopted at regional level (**Source:** Scarpellini et al., 2019)

Avdiushchenko and Zajaç (2019) focus on the regional implementation of CE in the Malopolska region, highlighting the key activities in this region's efforts towards circularity. These include the participation of the region in the international project SYMBI (*Industrial Symbiosis for Regional Sustainable Growth and a Resource Efficient Circular Economy*), funded by the Interreg EU programme, which the authors emphasise was crucial. The public policy instruments highlighted by the regional authorities include green public procurement and public-private partnerships. The participation of the region in the project led to the introduction of CE assumptions in its key operational and strategic documents. The region's waste management plan was updated, the main CE areas of the region were identified and IS was selected as the main instrument for CE realisation. Additionally, the spatial management plan for the region was updated to match the spatial management policy for support of the IS introduction. Regional authorities undertook other actions such as the development of educational campaigns, regional competitions, and promotion materials.

Sutcliffe and Ortega Alvarado (2021) focus on the Norwegian experience for CE adoption, more specifically the case of the Trøndelag county. Regional policymakers reveal that looking at best practices which can be implemented in the county helped considerably, along with the learning by doing approach of implementation and the scientific perspective represented by the local research communities. On sub-national levels, regional (county) and local (municipality) level, the CE concept was initiated via EU projects and international collaboration. Four main findings emerged from this study for regional players responsible for designing and adopting CE policies. First, in the case of Norway, the involvement of the national government with the subnational authorities was observed as unsatisfactory. Second, each level of government had each own stance on the desired scale of CE resource loops, county authorities vouching for regional loops, while municipal for local waste recycling and local services. Third, the actual implementation of the projects and learning in cooperation with researchers was deemed as positive. Nevertheless, the lack of common repository or knowledge base for exchange of experiences and knowledge was noted as a major drawback. Lastly, a certain degree of flexibility from the national government was considered as beneficial in the future so as subnational actors to have a space to execute according to local dynamics (Sutcliffe and Ortega Alvarado, 2021).

The Finish case is completely the opposite, where the regional CE roadmap for the Päijät-Häme, serving as a strategic instrument for CE implementation, was being inspired by the Finish national road map. The Regional Council and Lahti University of Applied Sciences, as the two main actors were funded by an Interreg EU Project. The roadmap was introduced as a segment of the regional development programme, focusing on resource efficiency, and closing material loops, but also highlighting the need for innovation with the goal to boost regional economic growth. The Finish experience show that in order to close biological loops systemic changes are need, implying a combination of regional policy interventions and practice-based business activities with longer vision (Vanhamäki et al., 2020). **Box 1** explains how the CE is concretised in S3's of 12 European regions.

Arbolino et al. (2020) cross-country analysis shows the discrepancies between the Italian regions in terms of CE adoption in the chemical sector. The results point that regional socio-economic context has a major role in advancing firms performance level while institutions and sectoral economic subtleties are not strong flywheel of CE. More specifically, they highlight the limitation of Southern regions in human capital and suggest education and environmental literacy as an instrument to be adopted by regional and local governments to alter economic actor behaviour. The need for a proper planning of the funds and effective recalibration of policy goals in the Southern regions is also noted. In light of that, the adequate planning and efficient institutions, as essential factors for public investment effectiveness, are pinpointed as fundamental for having greater benefits from the investments. Namely, Southern regions showed reduced benefits in comparison with Northern and Central regions, albeit the fact that they received larger portion of EU Structural and Cohesion Funds in the 2007-2013 Programming Period. The financial instruments supporting the CE implementation are outlined in detail in **Box 2**.

Compagnoni (2020) introduces the three policy instruments Italian regions use to advance circularity, namely Research and Innovation Strategies for Smart Specialisation (RIS3 or S3), single regional laws (RL) and Regional Waste Management Plans. The S3 is the most holistic instrument, though the most used one is the Regional Waste Management Plans where policymakers direct their efforts. This approach however is unsuitable for structural and all-inclusive transition towards the CE, considering that it is centred around the end-of-life principle, disregarding the production and consumption stages. Still, regional policies related

to waste management are instrumental for waste reduction and generating high-quality waste flows for recycling.

Box 1: Examining the spatial adaption of a CE through a conceptual framework of research and innovation strategies for smart specialisation (S3) in Europe

In their study, Vanhamäki et al. (2021) present a policy-based conceptual framework, of research and innovation strategies for smart specialisation (S3) in 12 European regions. In the planning phase the Thematic Priority Areas are defined initially, and afterwards the Construction of respective Transformative Activities follows, where a Roadmap is drafted, turned into Action Plan, obtained necessary Funding and ultimately the Monitoring and Evaluation mechanisms are adopted. Out of 12 regions, five have the CE in the name of the thematic priority area, while the policy and strategy linked to CE in the remaining seven regions similarly support S3, as stated in the narrative of the regional priorities. In the next stage S3 priority areas are translated into transformational roadmaps, and half of the regions in question have a roadmap, as a strategy or programme where regional CE targets are outlined (Brussels, Central Denmark, Southwest Finland, Päijät-Häme, Satakunta, Slovenia). In some cases, the CE strategy is a parallel document, in others S3 and CE are considered as separate documents functioning side by side. In the following regions the CE Roadmaps are being prepared: Häme, Luxembourg, Sud-Muntenia, Basque Country, while in Berlin and Brandenburg CE has a vital horizontal role in various sectors despite the lack of CE-specific Roadmap. The next stage is to translate the Roadmaps into Action Plans, being strategic documents with details regarding funding research, development and innovation actions, investments, involved stakeholders, schedules, monitoring and evaluation of the outcomes, and feedback mechanisms. Only Satakunta and Slovenia have advanced to this stage, while Southwest Finland and Päijät-Häme have demarcated specific segments of the CE, e.g., Päijät-Häme has Action Plan for the sub-priority 'bio-based CE'. When it comes to monitoring and evaluation, for most of the regions this is in progress, and only Satakunta, Slovenia and Päijät-Häme have defined targets to measure the CE. Lastly, Satakunta and Päijät-Häme have yearly updates and Basque Country has a revision projected to be happening every two and half years. Overall, the monitoring and evaluation phase is perceived as quite perplexing to be demarcated (Vanhamäki et al., 2021).

Box 2: Financial Instruments supporting CE implementation

The EC is providing a plethora of financial instruments to promote CE and resource efficiency, among which are: LIFE+; Horizon 2020; Public-private partnerships FoF (Factories of the Future); SPIRE (Sustainable Process Industries through Resource and Energy Efficiency); BBIJU (Bio-based Industries Joint Undertaking); Community of Innovation of the European Institute of Technology: Raw Materials, Climate, Food, Manufacturing and, Mobility and, the new Horizon Europe framework program. The EU Parliament, Commission and MS have ratified an initial pact with the European Investment Bank (EIB), with the new InvestEU programme, offering integration of the European Fund for Strategic Investments (EIF) and 13 other EU financial mechanisms. A wide range of financial instruments are provided by the EIB, including: InnovFin, InnovFin Thematic Investment Platforms, InnovFin Emerging Innovators, InnovFin Science, InnovFin Energy Demo project, InnovFin MidCap Growth Finance, InnovFin SME Guarantee Facility, European Fund for Strategic Investments, European Investment Advisory Hub, InnovFin Advisory, Green Bond. In the Italian context of financial instruments, the National Industry 4.0 Plan is aiming to facilitate the transition amid R&D in eco-innovation and eco-design (Sani et al., 2021).

Cramer (2020) gives an overview of the mechanisms used by Dutch provinces and regions to implement CE. The multi-actor initiative in the province of Utrecht designed the CE programme, 'Towards Circular Region Utrecht' in 2015. The provinces of Gelderland and Overijssel launched a cooperation alliance of triple-helix actors focusing on supporting SMEs to identify CE leaders and help them scaling up, as well as advance collaboration between mediators. In the Nijmegen region two waste management companies and cooperation alliance of 10 municipalities established the 'Circular Council' and drafted the CE programme in 2019. In 2016 the association Circular Friesland was formed, by the quadruple helix actors: business, research and education institutes, local government, and society. The formulation of a platform strategy was the initial activity, which considered the stakes of all actors, hence building co-ownership. The Mid-Brabant Region initiative, commencing in 2018, was concentrated on so-called 'makerspaces', common facilities where innovative solutions were developed and tested until market launch. The CE program of Amsterdam Metropolitan Area included two strategies: 1) centred around renewing product chains through circular procurement and 2) intending to close resource loops. Instruments for encouraging citizen's involvement were also part of it, along with initiatives directed towards development of knowledge and skills in CE in all educational levels (Cramer, 2020).

The findings of a recent study on three Belgian regions, Brussels, Flanders, and Wallonia, suggest that if CE is to be adopted in these territories, policy priorities in the respective interventions should be centred on 3R (Reuse, Repair, Remanufacturing) and Use Intensification, with a consideration of Sharing and Design Improvement (Towa et al., 2021). Lechner et al. (2021) introduce the 'Graz repariert' network, where with the public funding for repair Graz was the first EU city to establish a mechanism for electronic and electrical products repair. In this way the repair sector received boost, and consumers being incentives to use repair services rather than buying new products.

In their study Sastre et al. (2018) attempt to reason the diversity of MSW management strategies and different level of compliance with EU recycling targets among Spanish regions. They highlight the absence of enforcement mechanisms for implementing vertically the national measures to the regional level. Namely, the Organic Law 2/2012 anticipates the option of shifting EU penalties received at the national level to the Autonomous Communities (ACs), because of the nonconformity with the EU legislation, these penalties can be transferred only after the EU has imposed them in Spain. This is a lengthy process and the time lag is preventing the effective application of the enforcement. Additionally, there is absence of national coherent landfill tax outline, and in 2018 only three ACs had regional landfill taxes for MSW and Navarre was intending to introduce it in 2018. Last but not least, the authors propose setting a common ground for the separate waste collection of Food Garden Waste (FGW), making it compulsory in all ACs, deploying minimum tax rates in all regions in order to prevent landfilling and incineration. Similarly, Cutaia et al (2105) consider the Italian political system should make efforts to deter disposal and stimulate reuse and recycling of waste, since the existing tax on waste disposal on landfill from 1995 didn't yield the anticipated outcomes due to the low disposal costs.

In their study Agovino et al. (2020) calls for an efficient and transparent waste management, upholding the trust of the residents in local institutions. They specifically refer to the province of Treviso, where in 2000 kerbside collection mechanism and a PAYT (Pay-As-You-Throw) consumer charging instrument were initiated. The combination of these two mechanisms resulted in a rise of 17% in separate collection (from PAYT) and increased recycling by 15.7% (from kerbside) (Buccioli et al., 2015).

Boffardi et al., (2021) refer to an example of ineffective regional planning and implementation of measures, related to the Campagna waste management crisis which started in 1994. The regional government introduced separate waste collection targets and various infrastructures were foreseen to be built by 2000. The waste-to-energy plant became functional only in 2010, and the collection waste was stored in so-called ecoballs (high calorific packed waste to be burned) within the whole region. The investigation conducted by the Italian Courts revealed that these ecoballs cannot be burned according to EU and Italian law, due to inappropriate waste separation and high levels of arsenic (Greyl et al., 2013). Even today, around 5 tonnes of waste are still kept in the ecoballs since no processing solution has been discovered (Forte and Miotti, 2018).

Agovino et al. (2019) differentiate between hard measures (e.g., investments in infrastructures, instruments and means) and soft measures (encouraging environmental awareness directly and via promotion of culture) to optimise waste management process. Both local governments and society has in important role to play, and the integration of both hard and soft policy measures is a foundation stone towards achieving better waste management outcomes. Social norms, financial enticements and progressive collection systems can have a positive effect on the Separate Waste Collection Rate (SWCR) in all Italian municipalities. Some of the most notable examples of mechanisms and instruments used are covered in the following sections.

The Sardinian municipalities are highlighted as an outstanding example, where in a period of 8 years (2005-2013) the SWCR spiked from 9.9% to 51%. This achievement was partly attributed to the efficient use of EU funds which the island obtained within the EU regional policies promotion convergence among EU regions. Also, the launch and implementation of the regional waste management plan in 2008 contributed to the success, adopting the integrated waste management approach. Part of the plan was the introduction of new collection system (door-to-door collection) and new method of monetary penalties and rewards for local administrations: municipalities with high SWCR being rewarded and municipalities resorting to landfills beyond a defined limit were penalised. Last but not least, with the purpose to achieve economies of scale in collection the Sardinian municipalities created numerous consortia (Agovino et al., 2019).

In Naples municipality the efforts were directed towards hard measures, i.e., financial instruments that tried to tackle the absence of tools and disposal facilities, while the measures intended to foster the engagement of society were overlooked. In the remaining municipalities of Campania region on the other hand the soft measures were preferred, with local authorities establishing easy separate collection structures and motivated the residents to value the positive impact on the environment related to pro-environmental activities (Agovino et al., 2019).

Daddi et al. (2016) distinguish between 1) direct regulation and economic instruments and 2) voluntary tools for promoting eco-industrial activities. The former one being adopted by many EU countries, North America, and Asia, and the latter one being less preferred, despite the statement of some scholars for the need of both – active governmental policy and voluntary and proactive actions by companies (Korhonen et al., 2004). The Finish EIPs development is brought to attention, where instruments such as tax relief for the use of by-products as a possible tool for resource efficiency, higher taxes of transport and fuels along with limiting end-of-pipe emissions with the use of environmental permits are being utilised (Lehtoranta et al., 2011). Asian governments opt for the direct legislation and economic policies, for instance the IS in the Ulsan city was an outcome of strict legislation and environmental standards, while the high number of symbiotic initiatives in the Tianjin area (81 cases) were a result of economic instrument - local subsidies for high-quality infrastructure. On the other hand, the Tuscany Region launched the regional law known as Tuscan Regulation 74/2009 and Resolution 1245/2009 for founding the voluntary scheme enabling EIPs to achieve APEA certification (Daddi et al., 2016). Lombardi (2017) adds that the EU highlights the IS as key strategy for implementing CE, hence industrial symbiotic activities are considered as a tool contributing to the CE transition.

Brand and De Bruijn (1999) discuss the options for governments to stimulate IE at the regional level, claiming that the most effective model to be selected depends on the characteristics of the problem tackled, the desired behaviour of the other actors as well as the target group. Hence, in some instances, governments lack a legal basis for direct intervention and should adopt rather a stimulating role, compared to a coercive one. Alonso-Almeida and Rodríguez-Antón (2020) investigate the link between institutional theory and the adoption of environmental practices. Following the institutional theory *“institutions are organisations they*

have the power to formulate rules and reward compliance or sanction noncompliance to other organisations based on their superior position and legitimation”. According to Zeng et al. (2017), three types of institutional pressures are exerted, coercive, normative, and mimetic (see **section 2.5.6**).

Coercive pressure from governments proved to have significant positive or positive impact in changing the environment and behaviour. More precisely, Zhu et al. (2010) discovered coercive pressure to have positive impact on adoption of green procurement and recycling policies in firms, while Simpson (2012) uncovered that many countries enacted recycling laws after the ratification of the EU law for waste reduction. The study of Ranta et al. (2018) showed that regulatory instruments increased recycling activities, though not as effective as normative pressures. Overall engagement of many actors is needed for making progress, and regulation can contribute to boost the pace contingent on the position of main actors.

Last but not least, mimetic pressures are regarded as voluntary and self-imposed, acting as enablers when the other two types of pressures fail, beneficial in situation with high ambiguity and to reduce the risk to impel something novel. In cases of low societal awareness of the CE advantages, mimetic pressures are not so effective, and overall studies reported mixed findings. In the context of mimetic pressure, three sources of imitations were listed: frequency, trait and outcome based. The first one is when organisation adopt a specific behaviour purely because other are doing it – so regions can replicate the state positioning. The second one is an outcome of identification with certain traits (e.g., size, performance, proximity) and regions can imitate other regions because they identified themselves with them because of certain characteristic. Finally, the outcome-based imitation is when the leaders are being imitated for their achievement, though in the case of CE regional implementation this is less likely due to the lack of specific CE outcomes in regions (Haunschild and Miner, 1997).

In the case of Spain, the results showed that the most significant regulatory and legislative initiatives took place in 2017, and the focus was on waste management, followed by production and consumption, secondary raw materials and competitiveness and innovation. In the EU the legislative priorities were on competitiveness and innovation, waste management, production and consumption, and secondary raw materials. The contribution of this study is the developed matrix of institutional positioning of Spanish regions, based on

the number and diversity of CE initiatives, grouping regions into the following groups: followers, laggards, pioneers, and fashionistas. Additionally, the results of the study highlighted coercive pressure followed by mimetic as the most effective ones for the adoption of CE practices in the Spanish regions, while low normative pressure was noted (Alonso-Almeida and Rodríguez-Antón, 2020).

2.5.7.2 Industry/consumers/academia mechanisms for regional CE implementation

The previous section was mostly focusing on policy mechanisms for implementing CE, while this one will give a brief overview on the instruments and practices adopted predominantly by the industry, but also consumers and academia. The collected mechanisms are presented in **Table 20**.

Aranda-Usón et al. (2020) compiled the CE-related activities undertaken by business which have been reported in the literature and grouped them into four levels: Level I – practices linked to waste treatment and recycling; Level II – initiatives encompassing dematerialisation, secondary raw materials, and waste recovery; Level III – activities associated with eco-design and Level IV – practices including IS and/or IE (see **Table 20** for details). Difficulties arise, however, when an attempt is made to unveil the process that firms endure when adopting the CE. Additionally, studies tend to overlook the reason for adoption of CE-related initiatives – if it is to increase the firm’s level of circularity or to react to other requests. Nevertheless, the crucial role of local and regional authorities in instigating and implementing the transition is acknowledged, taking into regard that the shift towards Circular Business Model (CBM) is highly depended on the geographic territory where the companies are functioning (Aranda-Usón et al., 2020). Hence, as put by Stahel (2013) the transition is impacted by geographical proximity as the accessibility to local and regional solutions will enable cost reduction related to broader circuits resulting from a greater number of transactions.

Mihai and Grozavu (2019) refer to a Romanian example of a rural-urban nexus which fosters biowaste prevention and organic farming, where retailers and restaurants from hotels started a food waste diversion programme for sorting and distributing food waste in a rural bio farm (Ciocanesti, Dimbovita County). Cappellaro et al. (2020) attempted to examine the CE Good Practices (GP) in the region of Emilia-Romagna and adopted the GP definition provided by

the European Circular Economy Stakeholder Platform (ECESP): “Good practices are relevant initiatives, innovative processes and ‘learning from experience’ examples involving companies or other relevant stakeholders such as research, academia, and civil society”. A collection of regional CE GP was made and further analysis, which revealed that the majority of GP had strong links with waste prevention, considering that the predominant sectors were repair, reuse and refurbishment activities and home furniture, hence promoting closed-loop process adoption and product life-time extension. The authors claim that the CE GP proved to be an important tool to scrutinise the public policy effectiveness with regards to the CE transition (Cappellaro et al., 2020). Having into consideration that Emilia-Romagna region is one of the most advanced regions in the CE adoption, **Box 3** provides more details in this regard.

Study	Mechanisms for regional CE implementation
Sani et al. (2021) <i>Good practices from Emilia-Romagna region, mapped in the Italian CE Stakeholder Platform (ICESP)</i>	-Improving the recyclability of materials or the use of secondary raw materials -Prevention of production, collection, and selection of waste to for further use -Extending life span of a product through reuse/repair/maintenance/redesign -Smarter use of resources including energy resources in industrial processes -Introduction of new consumption models by providing consumers with information on the efficient or alternative use of products -Improvement of flows of resources and by-products through IS
Aranda-Usón et al. (2020) <i>Main CE-related activities adopted by businesses classified in four levels (see description in the section)</i>	<u>Level I. REC</u> 01. Reduction of the environmental impact of the company 02. Energy efficiency 03a. Waste recycling <u>Level II ‘DES’</u> 04. Renewable energy 05. Design for resource efficiency (“dematerialisation”) 06. Design for resource recovery 07. “Secondary raw materials” (recycled) <u>Level III ‘VALW’</u> 08. Product-life extension 09. Design for upgradability and multifunctionality 10. Eco-innovation <u>Level IV ‘SIM’</u> 03b. Internal recycling 11. Energy waste recovery 12. Industrial symbiosis and sharing (or similar)
D’Adamo et al. (2020) <i>Innovative initiatives (mostly linked to green chemistry sector) in Italy</i>	-Campania region: GFBiochemicals plant (manufacturing levulinic acid from biomass), Novamont Research Center (specialised in the progress of industrial biotechnologies) and “Rete 100% Campania” (cluster of firms in the entire paper supply chain, aimed at designing and producing sustainable packaging from local pulp waste). -Sardegna region: Versalis–Novamont biorefinery (manufacturing many high value-added bio-based products) -Puglia region: university spin-offs and start-ups

	-Sicilia region: Gela Biorefinery -Basilicata region: bioeconomy cluster and the ENEA green chemistry research centre
Poponi et al. (2019) <i>Tool to promote technology transfer</i>	Spin off enterprises as driver for development of circular business models and mechanism to enable the transition towards CE
Mihai and Grozavu (2019) <i>Initiatives by rural communities to combat illegal dumping</i>	-Traditional alternatives (home composting, animal feed, organic farming, recovery, and reuse of waste items at the household level) -Innovative solutions (e.g., upcycling or creative reuse, refurbishment of computers and other IT equipment)
Husgafvel et al. (2018) <i>Measures taken by the industry</i>	-Improve the material efficiency of production -Develop sectoral guidelines and best practices -Develop supply/value chain and energy use -New business models -Employee training

Table 20: Industry/consumers/academia mechanisms for regional CE implementation

Box 3: The case of Emilia-Romagna region

Emilia-Romagna is the first region in Italy that enforced a regional law on CE in 2015, with the goal to “*innovate waste management regional system, ensuring environmental and health protection and reducing the overall impacts due to resource use*”. The regional Waste Management Plan represents a vital implementation instrument of the regional CE law, setting even higher targets compared to the EU CE Package (Cappellaro et al., 2020).

A strong collaboration between industry and academic is present in the region, which was even more reinforced by the establishment of the regional collaboration network - Rete Alta Tecnologia (High Technology Network). The region offers training in several CE-fields, including design and eco-design, logistics and consumption, where more than 100 courses are available. Around 70 infrastructures (laboratories and research groups) are engaged in R&I matters in the realm of CE, among which is CERCIS (Centre for research on the CE, innovation, and SMEs) at the University of Ferrara. More than 430 R&I initiatives (with total value of over 67 million Euros) were recorded in the period 2016-2019, encompassing EU, national and regional projects as well as direct engagement with the industry. Finally, 29 patents were registered in the region mostly associated to tech-solutions for recycling and recovery. The ERDF Operational Programme (2014-2020), supported by the Regional Smart Specialisation Strategy funded tactical R&I projects in the field of green and blue economy, including 1600 researchers, 222 companies, 218 industrial research laboratories accredited to the Rete Alta Tecnologia, comprising 11 industrial projects tackling core CE matters (Sani et al., 2021). The regional infrastructure concerning technological and scientific skills proved to be encompassing the entire life cycle of the product, as opposed to the waste management focus as it is the case in other countries. The strong partnership developed between actors from the government, academia, industry, and research centres demonstrated great implementation results, mainly developed by projects at different levels. (Sani et al., 2021).

2.5.8 Regional circular economy measurement systems

According to Scarpellini et al. (2019), few studies focus on CE implementation at the regional level, and methodologies that can measure the establishment of CE in a specific territory remain under examination. As the EU has placed its emphasis on the regions, the measurement of eco-innovation is particularly important from a regional standpoint.

The importance of an available monitoring framework is also an issue tackled in several studies (Vanhamäki et al., 2021; Alaerts et al., 2019; Avdiushchenko and Zajač, 2019; Avdiushchenko, 2018). The primary aim of a monitoring framework is to assist governments at various levels with assessing the effects of CE policy interventions and identifying the actions required to direct the economy (Reichel et al., 2016). A monitoring framework should enable stakeholders to identify ways of contributing to a CE, taking into account the wider economic, environmental, and societal factors (Alaerts et al., 2019). The conceptual framework proposed by Avdiushchenko (2018) for CE regional monitoring, as well as covering these factors, includes spatial and cultural concerns impacted by CE adoption and should act as a driver of CE-based regional development.

Moraga et al. (2019) and Iacovidou et al. (2017) underline the lack a single indicator or methodology able to monitor every aspect of the CE. Moraga et al. (2019) argue this could be due to the lack of a commonly agreed concept of what CE should encompass is still missing, and Vanhamäki et al. (2021) adds the difficulties in defining and setting CE targets as a reason. Saidani et al. (2019) on the other hand argue that CE indicators exist though all-inclusive indicators and comprehension on the usability of the various types of indicators is still scarce. Vanhamäki et al. (2020) points to the case of Pääjät-Häme and its regional CE road map where the lack of clear indicators has been recognised. Bezama et al. (2019) debate that a proper set of regional indicators for evaluating and monitoring is necessary, to perform robust evaluation of circular and bio-based production systems. This set of indicators should consider not only the regional barriers and opportunities but also the related global challenges.

Vanhamäki et al. (2021) claims the monitoring of the direction of change can “*make the change more manageable from the regional development and policy point of view*”. However, their recent study revealed that for the majority of regions the monitoring and evaluation of the CE

strategies and action plans are in the development stage, indicating that regions have different approaches to monitor and assess the CE implementation. Slovenia stated they have defined targets, Satakunta region (Finland) general level defined targets, Luxembourg defined targets for one sub priority. Southwest Finland and Basque Country (Spain) stated their targets are under preparation while Päijät-Häme has target for one sub priority and the rest are under discussion. Berlin and Brandenburg (Germany) had no defined targets concerning CE, while Central Denmark had no specified regional targets. The rest of the regions did not have any targets yet, Brussels Capital Region, Häme (Finland) and Sud-Muntenia (Romania) (Vanhamäki et al., 2021).

Daddi et al. (2016) referred to the Chinese CE Evaluation Indicator System, established in 2007 by the NDRC, appropriate at both national and regional scale, with four groups: resource outputs, resource consumption, integrated resource utilisation and waste disposal/pollutant emission indicators.

Avdiushchenko and Zajaç (2019) and Alonso-Almeida and Rodríguez-Antón (2020) draw attention to the national focus of the EC CE monitoring framework and the limited focus on monitoring procedures for regional and local policies. This results in a gap between policymaking and practical implementation, which affects regional actors. This is a critical omission, as regions are the most significant administrative units for devising and implementing major EU policies. Furthermore, Avdiushchenko and Zajaç (2019) refer to the expected rebound effect of the CE transformation, and the support that monitoring procedures can offer to policymakers in the form of adjusting and revising strategies and actions. A final point made by the authors concerns the need to adapt strategies and actions based on the specifics of the regions' local CE practices. Hence, the authors suggest that, as a first step, regional authorities should adapt their existing regional development strategies or develop new ones based on CE principles and then develop a CE monitoring system.

Moreover, the deficiency of measures and evaluations that go beyond material and energy aspects in the circular urban economy is emphasised. This deficiency entrenches other segments linked to the culture of cooperation, synergies, and symbiosis, which are vital to the self-sustainability of urban and territorial systems. As pointed out by Gravagnuolo et al. (2019), the outcomes of their work highlight the following:

the existence of an open field of research related to the assessment of the circular city, through enriched urban metabolisms assessment that could take into account the economic, social, environmental, and cultural self-sustainability and self-regeneration capacity of circular cities and region.

Several studies review or refer to available indicators and measurement systems for CE evaluation at various level (Alaerts et al., 2019; Avdiushchenko and Zajač, 2019; Gravagnuolo et al., 2019; Scarpellini et al., 2019; Virtanen et al., 2019). Banaite and Tamošiuniene (2016) list the available CE evaluation systems: the regional CE development index, super-efficiency DEA model, evaluation of regional CE based on matter element analysis, integrative evaluation of the development of CE, material flow analysis (MFA) to evaluate CE, and an indicator framework for the evaluation of CE development in cities. Aranda-Usón et al. (2018) measured the adoption of CE by businesses at the firm level and analysed its impact at the territorial level (the Spanish region of Aragon). Christis et al. (2019) evaluated the possible effects of CE strategies on the primary material footprint (MF) and carbon footprint (CF) of households in the Brussels capital region. Volk et al. (2019) used MFA while Grippo et al. (2019) performed multi-criteria analysis. Gravagnuolo et al. (2019) identified criteria and indicators of circularity in the built environment sector, and Tazi et al. (2021) recommended a framework to close the loop of residential building materials in France. Additionally, stocks and flows of the consumed materials, construction and demolition wastes and recycled materials were evaluated using regional MFA analysis. Bianchi et al. (2020) introduced a new econometric model to infer regional estimates and applied it to derive DMC for over 280 NUTS 2 regions. According to the authors, their contribution is vital for developing place-based policies and strategies for facilitating sustainable resource use at regional levels.

The city of Napoli has been used as a case study for testing the Emergy Accounting method (EMA), a recommended comprehensive method along with EMA indicators to assess the adoption rate of CE patterns in local and regional systems. Authors claim this method is able to capture the enhancements resulting from CE strategies adoption, while common mono-dimensional indicators fail to grasp the holistic understanding of CE (Santagata et al., 2020). More specifically, LCA, MFA and other conventional methods are unable to fully capture the specificity of a closed loop CE framework, characterized by feedback loops, resource use minimization and quality assessment. On the other hand, EMA seems to be capable of measuring the improvements following the implementation of circular strategies by

evaluating the difference Δ between the total emergy U of the investigated system in a linear and a circular framework. The generated simulations in this work confirmed how EMA could be more beneficial compared to traditional methods when dealing with CE decisions, by providing suitable insights from a different perspective, anchored on environmental, spatial and temporal features, capturing resource generation (upstream), product (downstream) and system dimensions (Santagata et al., 2020).

Towa et al. (2021) claim the possible advantages and disadvantages of CE strategies both at national and subnational level are not comprehended enough, hence in their recent study they evaluated the possible environmental pressures of implementing a CE intervention (CEI) in Belgium and its three regions Brussels, Flanders, and Wallonia. The CEI encompassed “*Delayed Replacement (DR), Reuse, Repair, Remanufacturing (3R), Use Intensification (UI), Design Improvement (DI) and Sharing*”, and the respective results disclosed adoption of CEI practices both nationally and on regional scale can lead to a net reduction of environmental pressures. Furthermore, they highlighted the global interconnections among countries and regions which implies focused global contributions to address environmental pressures for CE shift.

Sánchez Levoso et al. (2020) proposed a methodological framework to enable adoption of CE strategies in urban systems (i.e., cities or urban regions), describing four main phases: 1) analysis of the context; 2) selection of implementation scope; 3) identification of CE opportunities and 4) roadmap for implementation. The importance of indicators is mentioned in two critical phases. Namely, in phase one, where the use of circularity baseline or circularity potential is elaborated; the former designating the current circularity level of specific territory, and the latter indicating areas having the greatest potential for implementation of CE strategies. Additionally, in phase four the importance of monitoring the initially set objectives and targets is stressed.

Towa et al. (2021a) tackled the issue of assessing the circularity of regions, defined as the “*proportion of materials recovered and reintroduced in that region of the total materials in that region*”. The authors claimed that current studies disregarded the trade of waste for treatment among regions when assessing the regional circularity. Hence, they suggested and tested two new indicators in Brussels, Flanders and Wallonia, the trade-corrected circularity index and trade-corrected circularity gap index. The results revealed that Brussels, Flanders, and Wallonia are

0%, 6.3%, and 8.1% circular, but when accounting the trade of waste for treatment their circularity changes to 7.7%, 6%, and 8.5%, respectively. Except the issue of trade of waste for treatment, the authors are also arguing the importance of import/export of waste management services. Finally, they are raising several important questions regarding measuring the regional circularity:

Is a region circular due to its capacities to recover waste? Or to its use intensity of recovered products? Or to its capacity to generate recoverable materials even if they are recovered and reintroduced in another economy? To which extent highly urbanised and service-oriented regions like Brussels are circular? What is the role or contribution of regions like Brussels in improving the degree of circularity of the world economy? (Towa et al. 2021a).

A regional study by Scarpellini et al. (2019) evaluated CE-related impacts using three key indicators of employment: turnover and the volume of raw-material consumption over the medium- and long-term. While this work makes a valuable contribution by developing a method for measuring regional adaptation of CE, additional work is required to assess the CE impact within a territory. Virtanen et al. (2019) propose indicators for measuring the circularity of material flows at the regional level, specifically the MF of phosphorous, plastics, textiles, waste wood, and ash. In addition, the work of Alaerts et al. (2019), although conceptual, is important, as it proposes a method of advancing the existing monitoring procedures of CE. This is achieved by introducing meso indicators to measure CE accomplishments and effects at the level of fulfilment of societal needs.

Avdiushchenko (2018) took the first step in proposing a CE-based regional development monitoring framework. The framework was based on five CE focus areas: economic, environmental, social, spatial, and cultural development. The CE concept in the EU is diverse in scope, focusing not only on resource efficiency, but also on innovation, circular business models, new consumption patterns, eco-design, green jobs, and so on. Thus, 12 pillars of CE-based regional development were proposed: *economically prosperous, innovative economy, zero-waste economy, energy efficient and renewable energy-based economy, bioeconomy, service/performance economy, socially oriented economy, smart economy, low-carbon economy, resource- and material-efficient economy, spatially effective economy, and collaborative or sharing economy*. This work is pivotal in developing the conceptual configuration for the CE regional development monitoring framework. However, the practical side of implementation depends

upon the development of concrete indicators and the potential to operationalise them, which in turn depends primarily on the availability of data.

Avdiushchenko and Zajaç (2019) built upon the previous conceptual study to suggest a wide range of specific indicators for each of the pillars. Namely, they suggested some main features the regional CE indicators should exhibit, such as: the chosen indicators should be relevant to CE implementation at a regional level, they should ensure comparability (using the NUTS level scale), they should be transparent and understandable for a larger group of stakeholders, and they should be based on official and accessible data. Of the 12 proposed pillars, or ‘dimensions’, only seven were chosen for the final recommended evaluation indicator system based on the NUTS 2 regional level. The dimensions, along with a set of 25 indicators, are presented in **Table 21**. The indicators proposed by the authors were selected on the basis of the specifics of the region, the availability of data, and the assumptions of a system of CE indicators for European regions. All the indicators form part of the CE index, which was constructed using principal component analysis (PCA) and tested in the Malopolska region (a NUTS 2 region in Poland).

No.	Dimension	Indicators	Units
1.1	Economic prosperity economy	GDP	Per capita, fixed prices, PLN
1.2		Average life expectancy at birth for men	Years
1.3		Registered unemployment rate	%
1.4		At-risk-of-poverty rate	%
2.1	Zero-waste economy	Municipal waste collected selectively in relation to the total amount of municipal waste collected	%
2.2		Municipal waste collected per one inhabitant	Tons/person
2.3		Industrial and municipal wastewater purified in wastewater requiring treatment	%
2.4		Outlays on fixed assets serving environmental protection and water management related to recycling and utilisation of waste	Per capita, fixed prices, PLN
3.1	Innovative economy	Expenditures on research and development activities	Per capita, fixed prices, PLN
3.2		Average share of innovative enterprises in the total number of enterprises	%
3.3		Adults participating in education and training	%
3.4		Patent applications for 1 million inhabitants	-
4.1	Energy-efficient and Renewable energy-based economy	Share of renewable energy sources in total production of electricity	%
4.2		Outlays on fixed assets serving environmental protection and water management related to electricity saving	Per capita, fixed prices, PLN

4.3		Electricity consumption	kWh/person
5.1	Low carbon economy	Carbon dioxide emission from plants especially noxious to air purity	Tons/person
5.2		Emission of particulates	Tons/1 km ²
5.3		Passenger cars	Cars/1000 population
5.4		Pollutants retained or neutralised in pollutant reduction systems in total pollutants generated from plants especially noxious to air purity	%
5.5		Outlays on fixed assets serving environmental protection and water management related to protection of air and climate	Per capita, fixed prices, PLN
6.1	Smart economy	Households with personal computer with broadband connection to Internet	%
6.2		Enterprises with access to the Internet via a broadband connection	%
7.1	Spatially effective economy	Forest cover indicator	%
7.2		Street greenery and share of parks, lawns, and green areas of the housing estate areas in the total area	%
7.3		Urbanisation rate	%

Table 21: Recommendations for evaluation indicator system for the CE on NUTS 2 level
(Source: Avdiushchenko and Zajač, 2019)

Arbolino et al. (2020) built a composite index - Circular Economy Index (CEI) aiming to assess the regional performance of the chemical sector and tested it in 20 Italian regions. D'Adamo et al. (2020) developed a socio-economic indicator for the bioeconomy (SEIB) in order to assess the socio-economic performance of the regional bioeconomy and tested it on 20 Italian regions. The indicator had two versions, one incorporating all bioeconomy sectors, and one only manufacturing and bio-energy sectors omitting all primary sectors. Generally, regions in the North were performing better using the first version of SEIB, while regions in Central Italy were scoring better with the second version of SEIB. Southern regions overall were lagging behind the national average in both cases. Arbolino et al. (2018) proposed a novel index to assess ecological industrial policy - Industrial Environmental Sustainability Index (IESI) with the use of Principal Component Analysis and applied in 20 Italian regions. Except the methodological contribution, the findings of the paper emphasise the crucial role of synergetic actions between private and public actors to encourage an ecological industry in Italy.

Silvestri et al. (2020) constructed two composite indicators - the Circular Economy Static Index (CESI) and the Circular Economy Dynamic Index (CEDI), allowing both static and dynamic

assessment of the CE performance of EU NUTS 2 regions. Both indicators had socio-health dimension, economic and environmental dimensions with different variables. The authors grouped the 169 EU regions into four categories based on CESI and CEDI. “Never give up” group comprises above-median performance for both indicators, including some of the most developed and innovative regions like Ile de France (France), Brabant Wallon, Antwerpen and Region de Bruxelles (Belgium), Berlin and Hamburg (Germany) and Catalonia (Spain). In the “Satiated and sleepy regions” group regions are ranking well in CESI but CEDI disclose low values and contains some of the wealthiest European regions like Freiburg (Germany), Comunidad de Madrid (Spain) and some of the more developed Italian regions. “The best is yet to come” category is showing low CESI values but high CEDI values, including mostly Eastern European regions. “We don’t mind” group is performing low on both indicators and incorporates most Italian regions. An interesting line of inquiry the authors are suggesting is to identify the reasons for diversity and/or similarity in CE performance in trans-border to neighbouring regions within one country, in order to investigate the role of national and regional institutions for promoting the CE practices (Silvestri et al., 2020).

Banias et al. (2020) refer to the EU Waste Framework Directive (WFD) and the EU Landfill Directive, which form the regulatory framework for EU MS to implement more environmentally conscious alternatives, based on the Waste Hierarchy view ranks first the practices related to reduce, reuse, recycling and energy recovery from waste, hence aspiring for waste prevention and landfill minimisation. In particular, municipal waste has been highly debated topic in the EU, despite being only 10% of the total waste created in the EU. As a result, many studies have focus on this area (Boffardi et al., 2021; Foschi et al., 2021; Towa et al., 2021b; Agovino et al., 2020; Campagnoni, 2020; Gardiner and Hajek, 2020; Patricio et al., 2020; Agovino et al., 2019; Mihai and Grozavu, 2019, Sastre et al., 2018), including the one of Banias et al. (2020) which adopted a Life Cycle Analysis (LCA) approach to assess municipal solid waste practices in the region of Central Macedonia.

Foschi et al. (2021) highlighted the complexity and heterogeneity of the Italian waste management system and focused on the plastic waste management strategies in Emilia Romagna region. The authors called on the Legislative Decree 152/06 on regional self-sufficiency on municipal waste management according to which every region must be able to

manage all generated waste within its borders. This led to emergent interactions between regional industrial, consortia and waste operators in order to manage internally the waste.

Agovino et al. (2019) addressed the issue of separate waste collection (SWC) in Italy, on municipal levels (NUTS 4), as public policy body and vital managerial entity. In the Italian case the waste management plans are being outlined at NUTS 2 level regions, the waste collection process being supervised by provinces (NUTS 3) and operational strategies implemented by municipalities (NUTS 4). Findings revealed that the quality of local institutions are the main driving force of SWC in Italy, though the morphological features of the area, the consumption of cultural goods and income level are also crucial. The three frontrunners appeared to be Sardinia, Veneto and most of Campania region, and the overall results advocated synergetic efforts of citizens and local governments to achieve positive outcomes, as well as combination of both soft and hard policy measures.

Boffardi et al. (2021) on the other hand, focused on the organic waste, presenting the biggest portion of urban waste, and characterised as valued resource to be transformed into soil improver, biogas, and energy. In this respect, the study proposed a Decision Support System (DSS) for policymakers, to advance existing methodologies for planning and handling organic fraction of MSW and offer acumens for public resource distribution. The model was tested on the data for Campania region, selected due to its ecological disaster rising from waste mismanagement.

Mihai and Grozavu (2019) examined the illegal waste dumping practices in rural communities in Romania. Even though the NUTS 2 regions are the most important administrative regions for regional policy implementation in the EU, encompassing environmental and waste management policies as well, in Romania these regions have no governmental responsibilities; their counties are ruled by a County Council, overseeing the adoption of policies at the local administrative scales (cities and communes). The results revealed big amounts of household uncollected waste discarded in the natural environment outside the official statistics of rural dumps. Some of the recommendations to address this issue were to advance collection efficiency, enhance law execution and supervise environmental authorities, as well as tackle educational and environmental awareness. Another recent study investigated the driving forces behind the separate collection of recyclable materials in 103 Italian provinces (NUTS 3

regions) from 2004 to 2011. The conclusion highlighted pillars of institutional quality (voice and accountability, rule of law and regulatory quality), as well as value added per inhabitant and involvement in environmental association as crucial for successful execution of the waste separation activity (Agovino et al., 2020).

Sastre et al. (2018) developed a model which allows systemic comparison of recycling rates across different scales (regions, municipalities etc.), and tested the model to identify the gap between the current management situation and the EU recycling targets. The Spanish case was chosen, since in Spain the regional level is important because the Autonomous Communities (ACs) must comply with the EU recycling targets according to the Spanish National Waste Management Plan, but the approaches the ACs chose to achieve that differ from region to region. The findings suggest the majority of Spanish regions must make deep changes in their waste management systems in order to reach the recycling targets set by the EU in the WFD. These modifications refer to increasing separate collection, improving waste treatment efficiency, and restricting the dumping of unsorted waste (Sastre et al., 2018).

Gardiner and Hajek (2020) advocated the regional scale as the most significant for adopting waste management policies, since regions and municipalities are accountable for separate collection systems and managing treatment facilities. Furthermore, they suggest considering local and regional characteristics when modelling economic and environmental effect of waste creation; a heterogeneity of the regions which wasn't properly reflected in previous studies. The implications of their study suggest traditional economic development policies do not suffice to decrease waste generation in European regions, and economic tools (e.g., charges and incentives) as well as eco-innovation policies shall be initiated to support regional transition towards CE. Campagnoni (2020) also stressed the importance of regional CE implementation, considering that local requirements and prospects linked with CE are very specific. Emilia Romagna, being the first Italian region to enforce the pay-as-you-throw (PAYT) taxation on urban waste, is the study region where the impact of PAYT on the amount of total and sorted urban waste created is assessed.

Patricio et al. (2020) developed a method for building waste profile databases and proposed a framework for detecting cases for industrial waste utilisation in a specific geographic region. The authors tested the method to investigate the possibility for IS in the Västra Götaland

region, where waste streams from bio-based companies are utilised to produce biogas. Towa et al. (2021b) performed an analysis of the waste footprints and waste treatments for Brussels, Flanders, and Wallonia, and emphasised the possibilities of multi-regional input–output tables (MRIOT) at subnational level. The highest waste footprint in absolute terms had Flanders, and the lowest Brussels. However, results revealed Brussels had highest waste footprint per inhabitant for direct waste, and Wallonia for indirect waste and stock depletion.

➤ Data sources

The data sources reported in the studies are collected in **Table 22**, indicating that most used state or regional agencies for the data collection. In addition, Banaite and Tamošiuniene (2016) make reference to some supranational institutions and agencies. However, the most important contribution in relation to data sources for the creation of indicator databases comes from Avdiushchenko and Zajač (2019), who identify various agencies and institutions on different levels (global, EU, national, regional, and local) that collect CE-related data. They also suggest another valuable source to be taken into account when devising a system of indicators for CE monitoring and evaluation – that is, the various European scoreboards, which are also mentioned by Banaite and Tamošiuniene (2016).

Study	Institution/Agency	Database/Reports
Foschi et al. (2021)		1.ORSO (Osservatorio Rifiuti Sovraregionale) 2.MUD (Modello Unico di Dichiarazione Ambientale) 3.PARIX 4.AIDA 5.AMADEUS 6.OSIRIS
Tazi et al. (2021)		1.Tabula project 2.INSEE 3.SDES
Towa et al. (2021); Towa et al. (2021a); Towa et al. (2021b)		1.EXIOBASE v3.3.17
Vanhamäki et al. (2021); Stanojev and Figuistafsson (2021)		1.EC Joint Research Centre's (JRC) Smart Specialisation Platform (S3P) 2.Eye@RIS3
Boffardi et al. (2021); Compagnoni (2020)	1.ISPRA (Italian Institute for Environmental Protection and Research)	
Agovino et al. (2020); D'Adamo et al. (2020)	1.ISTAT (Italian National Statistical Institute)	
Alonso-Almeida and Rodríguez-Antón (2020)	1.Instituto Nacional de Estadística	
Banias et al. (2020)	1.Eurostat 2.Solid Waste Management Association of Region of Central Macedonia (FoDSA)	
Bianchi et al. (2020); Gardiner and Hajek (2020); Silvestri et al. (2020)	1. Eurostat	
Patricio et al. (2020)	1.Eurostat 2.Portuguese Environmental Agency (APA) 3.Swedish Statistical Office (SCB)	

Arbolino et al. (2020)	1.Federchimica (Italian Federation of Chemical Industries) 2.ISPRA 3.ISTAT 4.TERNA-Rete Elettrica Nazionale (TERNA e National Energy Grid). 5.Regional Agencies for Environmental Protection (ARPA e Agenzia Regionale per la Protezione Ambientale)	1. INEMAR project databases
Christis et al. (2019)	1.Belgian Federal Planning Bureau 2.Belgian Statistical Office 3.National Bank of Belgium	1.EXIOBASE V2
Scarpellini et al., (2019)	1.Instituto Aragones de Estadística	
Virtanen et al. (2019)	1.Finnish Food Safety Authority (Evira) registrations 2.Finnish official digital reporting service VAHTI 3.Finnish national statistics	1.Environmental permits 2.Decisions under the decree for the utilisation of waste in earth constructions Decree 3.Projetcs data
Alaerts et al. (2019)	1.Federal Planning Bureau 2.Flemish Strategic Advisory Council 3.Belgian Extended Producer Responsibility organisation for cars	
Grippo et al. (2019)	1.ISTAT	
Agovino et al. (2019)	1.ISPRA 2.ISTAT	
Mihai and Grozavu (2019)		1.EPA environmental reports
Andretta et al. (2019)	1.Italian Regional Agencies for environmental services (i.e., Atersir in Emilia-Romagna Region or ATOs in other Regions) 2.Spanish local public environmental services (i.e., Ecologia, Urbanisme i Mobilitat office in Catalonia) 3.Eurostat	

Avdiushchenko and Zajaç (2019)	1.Malopolska Regional Statistic Office 2.Environmental Department of the Malopolska Marshal Voivodeship Office 3.Voivodeship Inspectorate of Environmental Protection 4.EUROSTAT* 5.National and Regional Statistical Offices of the Member States* 6.Regional Environmental Agencies* 7.European Environment Agency* 8.OECD* 9.UN (UNEP + other programmes related to CE)* 10.World Bank* 11.WTO* 12.ILO*	1.Resource Efficiency Scoreboard* 2.Raw Materials Scoreboard* 3.European Innovation Scoreboard* 4.Regional Innovation Scoreboard* 5.Digital Agenda Scoreboard* 6.EU Transport Scoreboard* 7.Consumer Conditions Scoreboard* 8.Consumer Markets Scoreboard* 9.Social Scoreboard*
Arbolino et al. (2018)	1.ISTAT 2.OECD 3.Eurostat 4.OpenCoesione 5.Terna 6.Italian Observatory	
Sastre et al. (2018)	1. Ministerio de Agricultura, Pesca, Alimentación y Medio Ambiente 2. Instituto Nacional de Estadística	
Banaite and Tamošiuniene (2016)	1.Eurostat 2.United Nations 3.European Environment Agency 4.OECD	1.Resource Efficiency Scoreboard 2.Raw Materials Scoreboard
Cutaia et al. (2015)	1.ISTAT 2.Eurostat	1.ERC (European Waste Catalogue) 2.PRODCOM Community Production 3.NACE 4.ATECO

Table 22: Used and proposed sources of data (**Note:** *Proposed source for creation of indicators' database)

2.5.8.1 Data availability issues

The issue of a lack of data and challenges in terms of data availability were encountered in several studies (Tazi et al., 2021; Towa et al., 2021; Towa et al., 2021a; Towa et al., 2021b; Arbolino et al., 2020; Baniyas et al., 2020; Bianchi et al., 2020; D'Adamo et al., 2020; Gardiner and Hajek, 2020; Mihai and Grozavu, 2019; Patricio et al., 2020; Silvestri et al., 2020; Agovino et al., 2019; Christis et al., 2019; Virtanen et al., 2019; Volk et al., 2019; Arbolino et al., 2018; Avdiushchenko, 2018; Sastre et al., 2018).

Arbolino et al. (2018) pointed out to the fact that the regional level represents a challenging territorial level for analysis, simply due to dearth of data, which was also corroborated by Bianchi et al. (2020) and Towa et al. (2021b). Aranda-Usón et al. (2018) noted the limited number of data sources, as well as the absence of a common methodology for measuring CE. Avdiushchenko and Zajaç (2019) reported difficulties with data accessibility, which restricted their opportunities to monitor CE in their study region. Towa et al. (2021) stressed the incomplete and reliable information both for country and regional levels for Belgium. Volk et al. (2019) communicated uncertainties in the data, while Mihai and Grozavu (2019) encountered lack of available data on rural municipal level (commune) concerning waste collection coverage. In their study of 8, 000 Italian municipalities (corresponding to NUTS 4 level), Agovino et al. (2019) revealed that around 10% of the municipalities in Italy did not provide data and hence were excluded from the analysis. The subnational data availability limitation was highlighted by Sastre et al. (2018), elaborating that the model they built could incorporate more detailed variables (e.g., other targets on waste management), but the absence of data prevented the authors from performing this investigation.

The absence of local and regional data was stressed as the most significant obstacle for performing local metabolism studies and the accessibility to harmonised and granular data underlined as being crucial for developing place-sensitive policies towards more sustainable economies (Bianchi et al., 2020). Patricio et al. (2020) highlighted IS as one of the powerful strategies for CE implementation, though their realisation is being obstructed from lack of adequately detailed data on the available industrial waste. Gathering facility level industrial waste information was characterised as time intense and frequently impossible due to

confidentiality issues. Nevertheless, their proposed method addressed this gap by providing projections.

Virtanen et al. (2019) listed numerous challenges that they faced during their data collection process, such as an inability to find regional-level data, inconsistency between sources and the specifics of their study region. The latter prevented the use of national figures, as these do not necessarily reflect the reality and the regional disparities. To overcome the challenges stated above, the authors used data from other regions (Christis et al., 2019), national data from Eurostat (D'Adamo et al., 2020), national figures (Sastre et al., 2018) or Silvestri et al. (2020) developed their index by using marginally altered period of analysis because Eurostat contained data gathered for different time intervals. The lack of current data for IO analysis was described as well-known to the IO community, therefore focused efforts in regularly updating the IO database is needed (Towa et al., 2021; Towa et al., 2021a). Additionally, Silvestri et al. (2020) employed proxy variables directly linked with carbon emission, because regional data and indicators of low carbon performance were unable in Eurostat. Bianchi et al. (2020) applied an algorithm that automatically tweaks the global variables to the national socio-metabolic profile. Gardiner and Hajek (2020) called for the EU to deliver regional data on municipal waste recycling, landfilling and incineration for testing purpose.

2.6 Synthesis of the findings

The review of the literature on the regional implementation of CE has highlighted a number of research findings, which are elaborated below.

I. General findings related to the field of regional CE

Overall, the **adoption of the CE at the regional level is underexplored and in infancy stage**. A dearth of relevant research was detected at the beginning of the process, indicated by the low number of related papers identified during the SLR process (**section 2.1**). As shown in **section 2.3.1**, 30% of the papers were published in 2020 and 20% in 2021 (from 1st January 2021 until 13th May 2021 when the data was extracted). This indicates that academic interest in the domain has only just begun to emerge. Additionally, as argued by Murray et al. (2015), the CE school of thought has developed from legislation rather than scholars, explaining why there is not yet a journal, editorial board, or group of faculties. These findings were also

corroborated in **section 2.4.4** where the analysis revealed rather individualistic approach for researching this field, with very few links for co-authorship and citations among the authors in the dataset, but also very loose citations links among sources (**section 2.4.5**). These fragmented results can be rationalised by the novelty of the field. Towa et al. (2021b) attribute the laggard studies at subnational level to the unavailability of detailed information at the subnational level but emphasise the importance of having subnational studies considering that they contribute local and national decision-makers to consider regional specifics.

A missing regional element and lack of multidisciplinary was also observed. The absence of regional science journals was noted (**section 2.3.2**), as well as a lack of representativeness concerning subject areas pertinent to regional development (**section 2.4.1**). The combination of a research outputs concentrated in few publishing sources and subject areas along with the self-referencing phenomenon identified (**section 2.4.6**) could imply that the impact of the research outputs is only to the tangent disciplines. This research gap is corroborated by the findings of a recent study (Marra et al., 2018). Bezama et al. (2019) also highlighted the need for bonds between different scientific disciplines, technology fields and sectors to *“implement value chains into regional value cycles as a sustainable management of regional resources”*.

The **close links between IS and CE** are well documented in the literature (**section 2.5.3**) (Compagnoni, 2020; Patricio et al., 2020; Husgafvel et al., 2018; Husgafvel et al., 2018a; Lombardi, 2017; Iacondini et al., 2015). According to Lombardi (2017) from local, regional, national to EU level, the IS is perceived as a strategic tool contributing to the CE. The 2015 CE package highlights the IS as a key strategy for implementing CE and the role of IS to global agendas such as the CE was acknowledged by global institutions (UN, OECD) and prominent global fora (G7, G20, Global Green Growth Forum¹, and World Circular Economy Forum). (Lombardi, 2017; Iacondini et al., 2015). Several studies referred to IS examples including Dutch Twente region (Yu et al., 2021), Spanish regions (Aranda-Usón et al., 2020), Italian Emilia-Romagna region (Cappellaro et al., 2020), Finish Päijät-Häme region (Vanhamäki et al., 2020), Polish Malopolska region (Avdiushchenko and Zajac, 2019), Landskrona industrial symbiosis programme (LISP) – Sweden (Mirata and Emtairah, 2005). The keywords co-occurrence analysis (**section 2.4.3**) confirmed these findings, showing the most dominant keywords after ‘circular economy’ are ‘industrial symbiosis’, ‘environmental policy’, ‘regional

development' and 'waste management' and the overlay visualisation situated these studies dealing with IS to be one of the earliest (also reported in **section 2.3.1**).

Many studies (27 papers) reported their **research context or data collected to be from Italian territories** (**section 2.3.3**), as well as the **majority of top contribution affiliations were Italian** (31 papers) (**section 2.4.2**). One of the most advanced Italian regions - Emilia Romagna promulgated the first regional law in Italy on CE in 2015 (Sani et al., 2021; Cappellaro et al., 2020; Taddeo et al., 2017). Another Italian region, proved as pioneer in the application of IE as a policy tool is Tuscany, launching the first EU environmental and industrial policy of a voluntary instrument targeting the development and diffusion of EIPs (Daddi et al., 2016).

II. Findings related to the implementation level

The **macro-, meso- and micro-level divisions need to be reconsidered**, as the macro-level is considered very broad in the current literature (Vanhamaki et al., 2019). Additionally, the term 'region' in the context of CE implementation embodies a multitude of geographic territories and is not used consistently (**section 2.5.2**). The **majority of the papers were focused on NUTS 2 regions** (**section 2.5.2**), supporting the argument of this research to base the sub-national implementation of CE precisely on these regions, as also suggested by Avdiushchenko (2018). CE activities are impacted by geographical proximity because the accessibility of activities at local and regional levels contribute to cost reduction in relation with broader circuits including greater number of transactions (Stahel, 2013). Regional resource loops despite for being preferred for their sustainability potential, they also contribute to supporting the regional business activities (Sutcliffe and Ortega Alvarado, 2021).

III. Policy-related findings

The mapping of the policies, strategic documents, action plans, and related legislation on various levels in the final dataset uncovered a high concentration on EU and international policies, leaving **regional-level policies almost unrepresented** (**section 2.5.4**). The challenges of translating higher level policies into regional and local arrangements and policies – and then implementing them – were also highlighted. Cramer (2020) and Vanhamaki et al. (2020) claim that national governments started engaging in the CE transition, but the **adoption of the CE in cities and regions is still in infancy phases**, while Murray et al. (2017) argue that the multifaceted knowledge base that policymakers require remains in the development

phase. Dąbrowski et al. (2019) claim that, despite the growing number of policies and strategies at different levels, the CE field cannot be considered mature. Furthermore, experience and knowledge of CE implementation in spatial strategies remains insufficient, and the **scale and place aspects do not receive the required attention** (McDowall et al., 2017).

Sutcliffe and Ortega Alvarado (2021) suggest that policies defined at national level shall avail some flexibility so that subnational authorities will have enough room to perform in a transformative manner considering the local context. According to Scarpellini et al. (2019), **the contribution of local and regional authorities to the introduction of and transition to a CE is vital**; hence, the CE should be translated into environmental regional planning. Henrysson and Nuur (2021) highlight the need for policy interventions, beyond sectoral involvements or requirements for more circular product design, in order to transition to a more CE. Namely, they call for policy actions directed towards **local factors being crucial for establishing** and maintaining institutional environment supportive of CE-based transformations. Also, policy actions advancing the capacity of current industrial regional clusters are needed. Finally, they recommend strategies concentrating on differentiating and maturing markets for circular goods and services, improving cooperation among regions via knowledge and technology transfer and upholding local knowledge and expertise. They argue the importance of comprehending the institutional dynamics and instruments for implementing CE and understanding where and what intervention is appropriate is vital for policymakers.

The policy review performed by Stanojev and Gustafsson (2021) uncovered that CE should be perceived as a wider sustainable development strategy which should also *“support Member States and regions to strengthen innovation for the circular economy through smart specialisations”*. They add that the **S3 approach will be a primary tool for detecting regions’ opportunities for progress, development, and CE**. Moreover, to pinpoint a smart specialisation strategy has been regarded as a tactical element in devising investment flows and having a key role in CE value chains and processes. The work of Vanhamaki et al. (2021) presented an original approach to investigate the spatial implementation of a CE using a conceptual framework of S3 in EU regions. One of the main suggestions was regions to concentrate on precisely denoted objectives and specific but amendable plans on how to attain the targets, with the purpose to take advantage of both S3 and CE. Despite the fact that both S3 and CE are novel and still in development, hence good regional practices of combining both are still not available, the

potential for synergies between these two approaches shall be acknowledged. Finally, the findings revealed that at least in some regions, promoting the CE as a strategic priority via the S3 has contributed to better identification of CE targets and interventions by concentrating on existing regional assets and potential competitive advantages. In the context of the S3 and CE, Compagnoni (2020) adds that S3 are the most holistic instrument for implementing CE at the regional level, compared to the single regional laws and Regional Waste Management Plans. That's because S3 are providing a multi-faceted policy mix based on medium-long run regional development ambition shared by many actors, which influences the innovation course of main economic areas.

IV. Findings related to the approach of implementation

The need for a balanced approach to implementation was acknowledged (section 2.5.5), combining both bottom-up and top-down initiatives, and the equal commitment of all stakeholders (Sánchez Levoso et al., 2020; Vanhamäki et al., 2020; Aranda-Usón et al., 2018). The transition towards a CE requires both the support of the government via top-down policy instruments and encouragement from the bottom in response to changing social preferences (Vanhamäki et al., 2020; EOI, 2016). The foundation of the policies should be on flexible and innovative governance model able to consider new structures of rules and actors capable of combining top-down and bottom-up processes (Nohra et al., 2020). Moreover, Bezama et al. (2019) point to the necessity of **regional clusters and networks**, where all relevant actors will be integrated and will then serve as **platforms for discussion and knowledge exchange**. The establishment of these (bioeconomy) regional clusters and networks will avail the critical regional mass to be determined (e.g., the correct actors and funding) which will in turn decide the technological advances required to accelerate the envisioned sectoral integrations. The need for a common repository/knowledge base collection of experiences and knowledge was also reported (Sutcliffe and Ortega Alvarado, 2021).

V. Findings related to drivers and barriers for implementation

Considering that **local drivers and barriers linked with CE are very specific**, regional authorities have a fundamental role in developing policies for CE transition (section 2.5.6). It is important to note that CE implementation differs in each region or city, depending on geographic, environmental, economic, and social factors among others, and that's why

Avdiuschchenko (2018) reminds on the importance of taking into account the region-specific drivers and barriers, along with the region-specific processes affected by CE. Henrysson and Nuur (2021) underlined the many structural changes across different types of regions, when a major industrial transformation is happening, refuting the one-size-fits-all approach. More specifically, when translating CE strategies to regional spatial scale, stakeholders are confronting major challenges in adjusting and governing prevailing sociotechnical systems and developing novel modes of production and industrial pathways. Furthermore, the significance of institutions in regard to economic and industrial change at the regional level including environmental governance is also pinpointed. Henrysson and Nuur (2021) state the **institutional environment can be found on both sides, as a driver and a barrier for the CE transition**, and institutional factors are main driving forces for outlining potential pathways for transformation. In this context, the results of a recent study highlighted coercive pressure followed by mimetic as the most effective ones for the adoption of CE practices in the Spanish regions, while low normative pressure was noted (Alonso-Almeida and Rodríguez-Antón, 2020).

VI. Findings related to mechanism/instruments for implementation

Additionally, as argued by Vanhamaki et al. (2019), **more comprehensive understanding of the CE mechanisms for implementation are vital** for CE to become an integral component of national and regional policies (**section 2.5.7**). Many policy instruments and industry practices were linked to waste management and recycling, which certainly are fundamental for the CE transition, but this approach is inappropriate to bring the structural and systemic change towards the CE, because it is focusing on the end-of-life phase (Compagnoni, 2020). In light of that, the adequate planning and efficient institutions, as essential factors for public investment effectiveness, are pinpointed as fundamental for having greater benefits from the investments (Arbolino et al., 2020). Sastre et al. (2018) pointed to a weak enforcement mechanism cascading downwards from the national strategies to the practical regional application of the foreseen measures in the Spanish regions. Additionally, they called for a harmonised regulatory framework on CE-related matters which will ensure homogeneous approach across all regions in the country. Hence, it is vital to further explore the types of mechanisms available to different regions and determining the correct combination of mechanism that should be introduced in different regions. The S3 was identified as the most

holistic instrument for implementing CE at the regional level (Compagnoni, 2020), and the work of Stanojev and Gustafsson (2021) and Vanhamäki et al. (2021) support that finding. Nevertheless, as revealed in the abovementioned studies, very few regions have the CE as a priority in their S3.

VII. Findings related to monitoring and measurement systems

Finally, the **lack of a regional monitoring framework and measurement system** was identified (**section 2.5.8**), supporting the findings of other recent studies (Avdiushchenko and Zajaç, 2019; Scarpellini et al., 2019; Avdiushchenko, 2018). The fact that only 27% of the papers were from quantitative nature (and additional 17% mixed studies) in way alluded to the underdevelopment of this side of the discipline (**section 2.3.4**). Vanhamäki et al. (2021) claims the monitoring of the direction of change can *“make the change more manageable from the regional development and policy point of view”*. However, their recent study revealed that for the majority of regions the monitoring and evaluation of the CE strategies and action plans are in the development stage, **indicating that regions have different approaches to monitor and assess the CE implementation**. The **underrepresentation of the social and environmental dimension** was also noted. Furthermore, Avdiushchenko and Zajaç (2019) refer to the expected rebound effect of the CE transformation, and the support that monitoring procedures can offer to policymakers in the form of **adjusting and revising strategies and actions**. This adjusting mechanism for regular update was noted in the Pääjät-Häme region, where the road map was designed as a process rather as a report (Vanhamäki et al., 2021; Vanhamäki et al., 2020), but also in Satakunta region and Basque Country (Vanhamäki et al., 2021). Towa et al. (2021a) claim that current studies disregarded the trade of waste for treatment among regions when assessing the regional circularity. They also pointed to the fact that policy makers and researchers are addressing separately waste, resources and emission and called for an *“integrated approach nesting inputs and outputs”*, which can emphasise the system dynamics and trade-offs between a more circular and environment-friendly economy. Additionally, in the new global economy, the interconnectedness effects of countries and regions hereditary to the CE dynamics shall be considered and incorporated into foreign policies both at EU and international scale (Towa et al., 2021). Silvestri (2020) proposes as a future line of inquiry behind the factors for the diversity or similarity in CE performances in trans-border or neighbouring regions within the same country, in order to analyse the role of

national and regional institutions in stimulating and supporting the CE transition. The **lack of regional data issue and challenges in terms of regional data availability** were encountered in many studies (Tazi et al., 2021; Towa et al., 2021; Towa et al., 2021a; Towa et al., 2021b; Arbolino et al., 2020; Baniyas et al., 2020; Bianchi et al., 2020; D'Adamo et al., 2020; Gardiner and Hajek, 2020; Mihai and Grozavu, 2019; Patricio et al., 2020; Silvestri et al., 2020; Agovino et al., 2019; Christis et al., 2019; Virtanen et al., 2019; Volk et al., 2019; Arbolino et al., 2018; Avdiushchenko, 2018; Sastre et al., 2018).

2.7 Limitations of the study

This review has several limitations, primarily due to the type of review chosen. In particular, this is due to the use of scientific databases and the methodological decisions around search strings, filters, and inclusion/exclusion criteria. Relevant materials not listed in one of the selected databases may have been inadvertently excluded, alongside grey literature that could have offered a significant contribution to the topic. Additionally, pertinent articles written in other languages have not been taken into account. Another major limitation was the manual data handling and screening process, which could have resulted in relevant content being overlooked and excluded. Finally, although the process was well documented, transparent, and structured, the analysis of the content and the classification of information was inevitably influenced by researcher bias.

Limitations related to the performed analysis should also be acknowledged. The ranking of articles, journals and authors is founded on local and global citations. Hence, the latest published articles did not make it to the top rankings yet, since certain period (2 to 3 years) must pass for a paper to gain a reasonable number of citations (Goyal et al., 2021). It could be inferred those outstanding contributions published in 2020 and 2021 (comprising 50% of the total articles for analysis) did not appear in the most cited ranking due to this constraint. Last but not least, the content analysis might generate interpretation bias, however, the systemic multi-method approach which was applied (descriptive, bibliometric, and content analysis) contributes to mitigating these limitations.

Chapter three: Grey Literature Analysis

3.1 Context of the analysis

The Industrial Revolution marked a new era of global growth that triggered a wave of breakthroughs, technological advancements, and digitalisation. All these developments were reflected in the twin forces of uncontrolled consumption and production. Nevertheless, all this growth and prosperity was not evenly distributed, which led to poverty and inequality. The visual presentation of this is depicted in **Figure 26**, shown as a two-sided spiral. The benefits scored on the upward side of the spiral were achieved at a cost to the environment, and they placed substantial pressures on the planet's lands, waters, forests, and other natural resources. The downward spiral of environmental degradation, loss of biodiversity, accelerated resource extraction and resource scarcity was moving in the opposite direction at an equally overwhelming pace. All this was *"driving forward the new model of take-make-waste; and ever since, we have been headed in the wrong direction on circularity. As a result, the global engine of change is stuck in reverse"* (Circle Economy, 2020). However, as the World Commission on Environment and Development stated in the UN report Our Common Future in 1987: *"the environment is where we all live; and development is what we all do in attempting to improve our lot within that abode. The two are inseparable... What is needed now is a new era of economic growth - growth that is forceful and at the same time socially and environmentally sustainable."* This new era of sustainable development, whose need was acknowledged more than three decades ago, can be attained only by a deeply transformational change of the whole socio-economic system. Central to the entire idea of transitioning towards a more sustainable economy is the concept of CE which promises to yield positive societal benefits, design waste out of the system and decouple growth from resource consumption (Arsova et al., 2020).

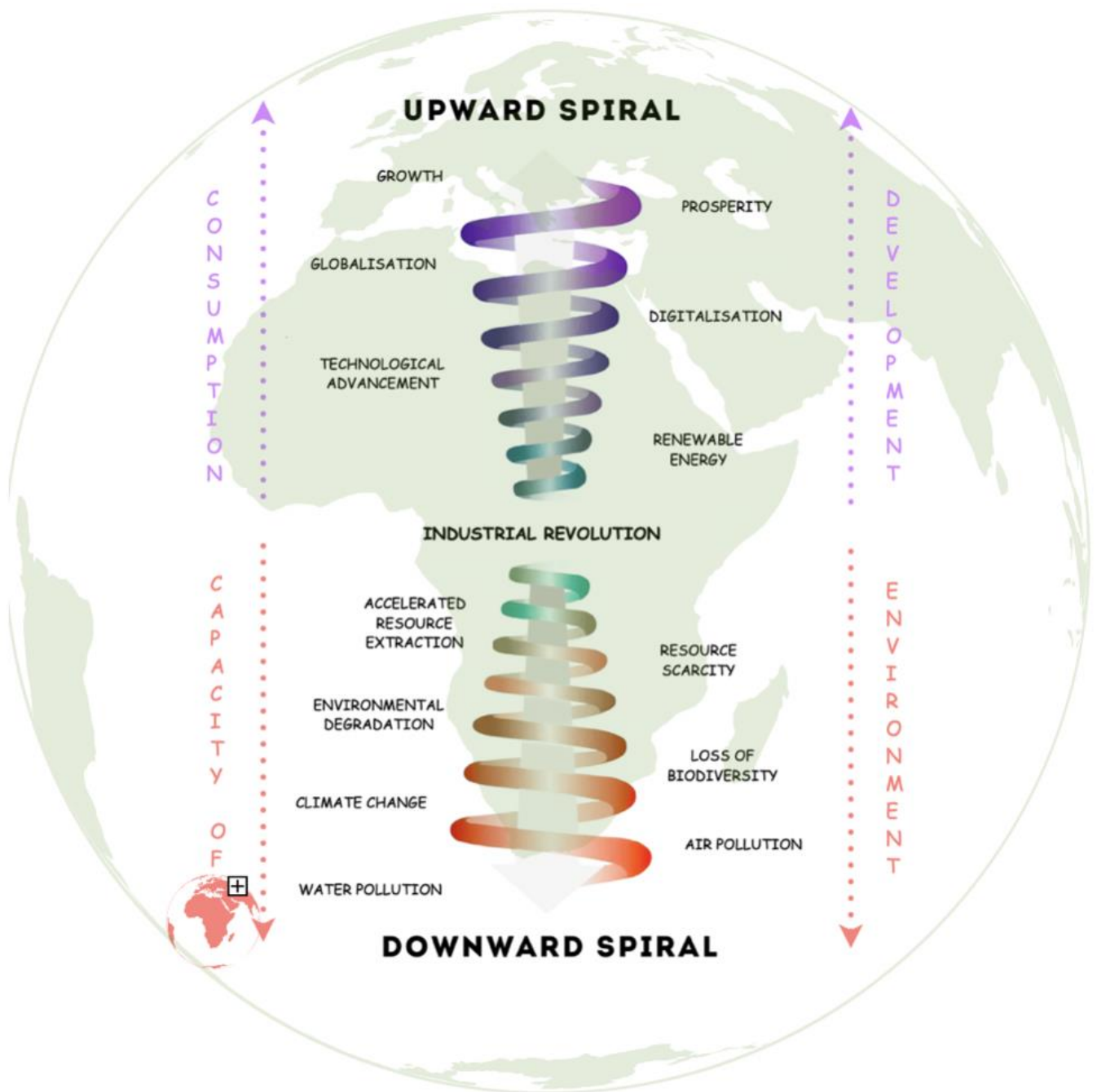


Figure 26: The Industrial Revolution Spiral (Source: Arsova et al., 2020; adapted from: Circle Economy, 2020)

3.1.1 The decoupling hypothesis and green growth

A vital concept closely related to CE is the decoupling of resource consumption from economic growth. This crucial step in the transition can be defined as either relative or absolute, the former describing economic growth occurring at a faster pace than resource

consumption (denoting efficiency gain), while the latter refers to a fall in resource consumption despite increased economic performance (Madden et al., 2019). Nevertheless, the question of decoupling, related to the possibility of green growth, is a matter of intense political deliberation between green growth and post-growth supporters. The recent report from the European Environmental Bureau (EEB) presents a review of the empirical and theoretical literature on the validity of the '*decoupling hypothesis*', and the conclusions are revealing:

not only is there no empirical evidence supporting the existence of a decoupling of economic growth from environmental pressures on anywhere near the scale needed to deal with environmental breakdown, but also, and perhaps more importantly, such decoupling appears unlikely to happen in the future.

Taking these decisive findings into consideration, policymakers must accept that tackling environmental issues necessitates a '*direct downscaling of economic production and consumption in the wealthiest countries*'. Therefore, the report proposes complementing *efficiency-oriented policies* with *sufficiency policies*, with a priority shift and accent from the former to the latter, while acknowledging that both policies are instrumental (Parrique et al., 2019). Furthermore, according to Hickel and Kallis (2020) "*there is no empirical evidence that absolute decoupling from resource use can be achieved on a global scale against a background of continued economic growth*" (Ortega Alvarado et al., 2021).

Moreover, Zink and Geyer (2017) claim the decoupling narrative proved to be problematic, often due to the lack of coordination, remanufacturing, and recycling, which ultimately means there is no decrease in production and, hence, no environmental benefits (Arsova et al., 2021). Current researchers question the core of the CE, asking whether closing material and product loops actually prevents primary production. Zink and Geyer (2017) claim that the economic element of the CE has been overlooked, and CE activities ultimately increase overall production, which can partly or entirely counterbalance their benefits. *Circular economy rebound* then occurs, when CE activities either fail to compete effectively with primary production or reduce prices, hence increasing shifting consumption patterns (Zink and Geyer, 2017). Following this, managerial efforts should not be directed to simply closing material and product loops, but rather to causing the *displacement* of primary production. Likewise, a priority shift is required to maximise the 'utility' of the product or material to maximise the *displacement potential* of end-of-life goods (Zink et al., 2014). In conclusion, the environmental

outcome of the CE is vague, since closing the material loops is not sufficient to ensure environmental improvement (Arsova et al., 2021b).

3.1.2 Structure of the chapter

However, the popularity of the CE concept is not limited to the academic community, but primarily among policymakers (Avdiushchenko, 2018). Murray et al. (2017) makes an interesting observation on the difference between CE and most other schools of thought on sustainability: namely, that CE originated in legislation: *‘It could be an explanation of why the CE has not yet acquired a journal, editorial board, and group of faculties of its own, as these are the normal territorial markings of a group of academics’*.

Therefore, **chapter 2** reviewed the relevant academic contributions in order to identify the existing research gaps which needs to be tackled, and **chapter 3** will complement the knowledge base by analysing the grey literature. Namely, the recent developments in the EU policy fora will be initially presented to set the ground for more local policy efforts to be presented afterwards. The practical insights regarding the measurement systems will be briefly denoted, as well as drivers and barriers encountered at the regional level for adopting CE activities. The grey literature which will be analysed for this purpose will include policies, strategies, action plans, regulations, directives, and public reports prepared by either public institutions or Think Thanks. Finally, with the purpose to verify and complement the findings from the literature review, a secondary data analysis will be conducted for selected EU regional strategies and action plans for CE transition. The selection strategy and process will be explained initially, and the results per region will be presented in so-called Regional Blueprints.

3.2 Recent CE related developments in the EU

The EU Council presented some very relevant conclusions in October 2019, in a statement entitled *“More circularity - Transition to a sustainable society”*. Regarding the Circular Economy Strategy 2.0, the Council acknowledged that:

“[...] the Union’s circular economy policy action has been successful, but STRESSES that more numerous, more ambitious and further scaled up actions are necessary to lead to a systemic transition in which circular, safe and sustainable climate-neutral production and consumption models and nature-based solutions become competitive and mainstream” (p.7).

The outcome proceedings of the meeting were providing very insightful information on the importance of regions for the CE transition and the EU Council was very vocal on that. Namely, the significantly improved resilience and competitiveness of the regions from a CE-implementation point of view, was underlined, but, at the same time, the Commission and individual MS were encouraged to consider the different social and economic conditions in various regions across the EU, in order to ensure a fair and inclusive transition. This could be inferred from Articles 8 and 9 (p.7):

“(The Council) URGES the Commission and the Member States to integrate the circular economy into all relevant policies and strategies, including the future 8th EAP, and make it one of the cornerstones of the long-term vision of the Union’s industrial future;

UNDERLINES that a circular economy can significantly improve the resilience and competitiveness of businesses, societies, cities and regions;

ENCOURAGES the Commission and the Member States to take into account the diversity of situations in the various regions of the Union, including the outermost regions, and the social and economic effects of the transition, and to take appropriate measures to ensure a fair and inclusive transition for all, taking care especially to prevent adverse effects on the most vulnerable”

The fundamental role of cities and regions was emphasised again in Article 13 (p.8), where the Council:

“UNDERLINES that cities and regions play a pioneering role in the transition to a circular economy and function as hubs for circular change; ENCOURAGES the Commission and the Member States to mobilise and support regions and cities to draw up concrete action plans for a safe and sustainable climate-neutral circular economy, to improve waste management through policies, investments and pilot projects, and to create innovation platforms that activate the private sector and encourage industrial symbiosis between companies in order to minimise resource use”

In relation to the global efforts to support a shift from linear to circular production and consumption in order to reduce marine litter from both land- and water-based sources, among other things the Council stressed the need for strong and effective regional cooperation with countries bordering the Union. Furthermore, when addressing the water scarcity and drought in the Union the Council encourages the EC and the MS along with stakeholders, to

promote water reuse and reduce water leakages considering regional conditions across the Union as appropriate.

The role of the final consumer in the transition was also not overlooked. In that regard, Article 27 (p.14) provides the following statement:

“(The Council) STRESSES the key role of the consumer in the transition towards a circular economy; ENCOURAGES the Member States to work with regional and local authorities, use policy tools, education, and economic incentives to support lifestyle changes, which benefit both the environment and people’s skills, health and well-being; in this regard, INVITES the Commission to develop product information instruments aimed at consumers on elements such as product lifetime and reparability, and to consider how to incentivise consumers to contribute more to the circular economy; CALLS FOR digital solutions to improve the sharing of information, products and services in order to empower citizens to become active participants in co-creating solutions for a circular economy”.

The role and importance of regions is not neglected even when analysing the most recent developments within the EU, which is the newly presented European Green Deal by the European Commissions’ president Ursula von der Leyen, vowing to “leave no-one behind” in the race to achieve a climate neutral economy by 2050. The Green Deal is an integral part of this Commission’s strategy to implement the United Nation’s 2030 Agenda and the sustainable development goals, and the other priorities announced in President von der Leyen’s political guidelines (Arsova et al., 2020a).

The increased cross-border and regional cooperation needed for clean energy transition and achieving climate neutrality combined with smart infrastructure was highlighted. Additionally, the launching of the European Climate Pact by March 2020 was mentioned as a way to engage with the public on climate action. The Pact will

“Continue to work to empower regional and local communities, including energy communities. The urban dimension of cohesion policy will be strengthened, and the proposed European Urban Initiative will provide assistance to cities to help them make best use of opportunities to develop sustainable urban development strategies. The EU Covenant of Mayors will continue to be a central force. The Commission will work with it to continue to provide assistance to cities and regions that want to commit to ambitious pledges on climate and energy policies. It will remain an essential platform to share good practices on how to implement change locally” (p.23).

Figure 27 below depicts the various important elements of the Green Deal which has the overarching goal to transform Europe’s economy for a sustainable future (European Commission, 2019).

Among the several actions plans is also the Mainstreaming of Sustainability in all EU policies, within which the EC suggests a Just Transition Mechanism (JTM), including a Just Transition Fund (JTF) to ensure no social marginalisation during the transition. This mechanism will concentrate on the most dependent and affected regions and sectors by the transition (i.e., fossil fuel dependency, carbon-intensive activities etc.). The funds will be oriented to foster processes that could support the low-carbon ambitions and climate-resilience. Additionally, support will be provided to citizens and workers that are most affected by the transition. The official communication of the EU Green Deal clearly states that the EC will work not only with Member States, but also regions, in providing them support to establish and implement territorial transition plans (European Commission, 2019).

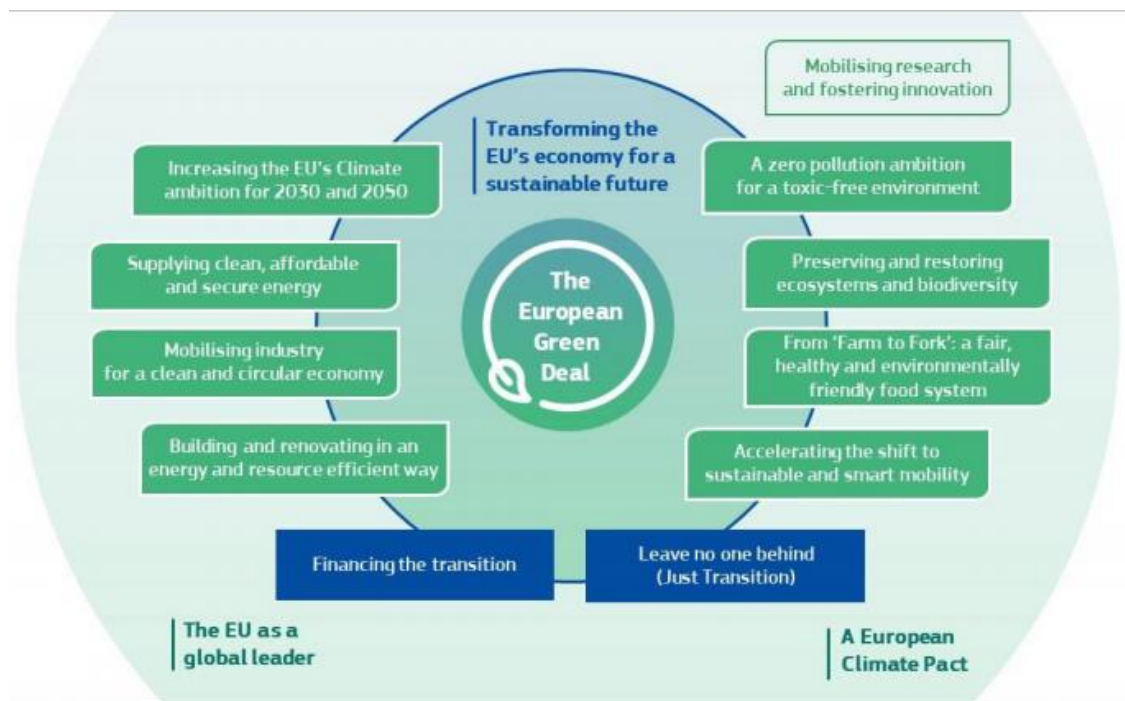


Figure 27: The European Green Deal (Source: European Commission, 2019)

At least 30% of the InvestEU Fund will contribute to fighting climate change, offering the Member States the option to use the EU budgetary guarantee e.g., to deliver on climate related cohesion policy objectives in their territories and regions but also to strengthen the cooperation with national promotional banks and institutions, which can encourage an overall greening of their activities. The Commission will also work with the European Investment Bank (EIB) Group, national promotional banks, and institutions, as well as with other international financial institutions. The EIB set itself the target of doubling its climate target from 25% to 50% by 2025, thus becoming Europe's climate bank (Arsova et al., 2020a).

The JTF precisely will draw on sources of funding from the EU budget as well as the EIB Group to leverage the necessary private and public resources. The mechanism will come in addition to the substantial contribution of the EU's budget through all programmes directly relevant to the transition, as well as other funds such as the European Regional Development Fund and the European Social Fund Plus (Arsova et al., 2020a).

This approach is in great line with the 5 policy objectives (CoR, 2019) of the new programming period of the EU (2021-2027):

- PO1: a smarter Europe – innovative and smart industrial transformation;
- PO2: a greener, low carbon Europe – clean and fair energy transition, green and blue investment, circular economy, climate adaptation and risk prevention;
- PO3: a more connected Europe – mobility and regional ICT connectivity;
- PO4: a more social Europe – implementing the European Pillar of Social Rights;
- PO5: Europe closer to citizens – sustainable and integrated development of urban, rural, and coastal areas through local initiatives.

According to (CoR, 2019),

“The key novelty of the new programming period is the high focus on environmental issues. The majority of ERDF funding (65% to 85%) will focus on smart growth and the green economy, while the fund will also support activities such as connectivity, social issues, and local development. The Cohesion Fund will continue to focus predominantly on environmental and transport infrastructure. Both funds are expected to contribute to the EU's overall 25% commitment to the climate objective. Investments under the whole ERDF financial envelope are expected to contribute 30% to climate objectives, while this percentage rises to 37% under the Cohesion Fund.”

Nevertheless, further support and priority is needed for less developed EU countries and especially for the Eastern EU block which are currently prioritising infrastructure development rather than business and social issues.

3.2.1 The EU CE Action Plan and Final CE Package

In 2015, the EC adopted an ambitious Circular Economy Action Plan (CEAP), which includes measures that will help stimulate Europe's transition towards a CE, boost global competitiveness, foster sustainable economic growth, and generate new jobs. In the CEAP the economic actors (businesses and final consumers) are described as a key in driving this transition, the authorities (local, regional, and national) are enablers of the transition, and the

EU has an overarching fundamental supporting role. The EC highlights that turning the plan into a reality will entail a long-term involvement at all levels, from MS, regions to cities, businesses, and citizens (Arsova et al., 2020a).

The Commission also promotes waste prevention and reuse through the exchange of information and best practices and by providing Cohesion Policy funding for projects at local and regional level, including interregional cooperation. Innovative forms of consumption can also support the development of the CE, e.g., sharing products or infrastructure (collaborative economy), consuming services rather than products, or using IT or digital platforms. These new forms of consumption are often developed by businesses or citizens, and promoted at national, regional, and local level. The Commission supports these new business and consumption models through Horizon 2020 and through Cohesion Policy funding. Regarding the waste management, the EC is committed to provide technical assistance to MS encountering difficulties in implementation and to facilitate exchange of best practices with countries and regions that have successfully improved their waste management. The importance of raising consumer awareness in order to change behaviour to prevent food waste is also acknowledged, by supporting awareness raising campaigns at national, regional, and local levels and the dissemination of good practices in food waste prevention. In terms of investment and innovation, important R&I funding opportunities are offered under the Cohesion Policy, with the CE being as one of the priorities highlighted by MS and regions in their Smart Specialisation Strategies (European Commission, 2015).

On 4th March 2019, the EC adopted a comprehensive report on the implementation of the CE Action Plan. The report presents the main achievements under the Action Plan and sketches out future challenges to shaping our economy and paving the way towards a climate-neutral, circular economy where pressure on natural and freshwater resources as well as ecosystems is minimised. This report, being a key document of the Final Circular Economy package, clearly states that achieving circularity should remain a pillar of the new Cohesion Policy over the 2021-2027 programming period. The Commission's proposal for a new ERDF and Cohesion Fund situates the CE as a priority in EU's efforts to achieve a greener and smarter Europe and excludes investments in landfills and facilities for the treatment of residual waste, in line with the waste hierarchy (Arsova et al., 2020a).

The strong stakeholders' engagement is vital for the transition; the systemic approach of the CEAP (2015) has given to all stakeholders a framework to replicate in order to foster partnerships across sectors and along value chains. Most of the MS have devised (or are in the process of devising and adopting) national strategies for the transition, and these frameworks are being replicated at lower levels, such as regional and local, which according to the EC brings the CE closer to the citizens and businesses. Another important initiative worth noticing is the establishment of the European Circular Economy Stakeholder Platform which brings together numerous networks and initiatives in the field. The Platform is a joint initiative by the European Commission and the European Economic and Social Committee (EESC), and it was launched in March 2017. It acts as a multiplier for best practices from the public and the private sectors and only in one year of operations, the Platform gathered and disseminated more than 300 examples of best practices, strategies, and reports. The Platform brings together stakeholders active in the broad field of the circular economy in Europe. As a “network of networks”, it goes beyond sectorial activities and highlights cross-sector opportunities, providing a meeting place for stakeholders to share and scale up effective solutions and address specific challenges. The Platform bridges existing initiatives at local, regional, and national level, and supports the implementation of the CE. By sharing among other levels, also regional level practices, strategies, case studies but also contacts of regional stakeholders and governments, the Platform definitely contributes to the transition to the CE (European Commission, 2019).

3.2.2 Smart Specialisation Strategies (S3) in the climate mitigation context

The system challenge that Europe is confronting to become the first carbon-neutral continent by 2050—and the enormous investment flows this requires—remain unprecedented. In the Green Deal Communication, the European Commission solicited policies and provided directionality to funding in a wide range of areas. Smart specialisation strategies (RIS3 or S3) that concentrate on new development prospects for all regions in these areas cannot be disregarded in such an approach (European Commission, 2019). In the programming period 2014-2020, within the Cohesion policy, more than 120 S3 were developed which directed R&I investments activities of over EUR 40 billion. In the programming period 2021-2027 S3 is

anticipated to have a major role towards regional development, cohesion, and green transition (Harding et al., 2021; Larosse et al., 2020).

The realisation of the Green Deal requires the mobilisation of all resources and all stakeholders across the whole EU. The assignment of smart specialisation is precisely that: pinning down new prospective activities, taking into account the unique characteristics of all places (Arsova et al., 2021). Larosse et al. (2020) position the RIS3 as a fundamental delivery mechanism for the EU's new sustainability agenda, contributing to the capitalisation from the diverse EU innovation ecosystem and circumventing fragmentation. Additionally, it can integrate the orientation of the Green Deal strategy with the search and cocreation alley (entrepreneurial discovery process (EDP)) in the direction of sustainable growth in all European regions. EDP, typical for S3 and not for traditional industrial and innovation policies, is an inclusive process where relevant local actors pinpoint possible activities within the S3 context and inform the government (S3 platform). Both the Green Deal and RIS3 are perceived as transformational policy frameworks, and RIS3 seeking directionality and place-based dynamics can be beneficial for the Green Deal. Hence, the RIS3 is a key element of Green Deal success (Larosse et al., 2020).

RIS3 represents a multilevel policy approach. The EU's new sustainability agenda is described by Larosse et al. (2020) *'as a smart specialisation strategy for the whole of the EU in a global economy in transition, claiming global leadership in clean technologies and exporting successful solutions'*. Nevertheless, worldwide reorganisation of value chains for sustainability will involve decoupling material and immaterial manufacturing (design globally, produce locally). Furthermore, Larosse et al. (2020) add the following:

This "de-globalisation" of material flows (because of internalisation of transport costs and more efficient digital technologies for local production) will be an opportunity for the re-industrialisation of Europe with a circular economy model, closing loops at the level closest to the users of customised product-service combinations. In such a transition, the capacities of quadruple-helix clusters in EU countries, regions, and cities, to adapt to the new sustainability enhancing regulations with new technologies and new social contracts, is our best competitive asset (Larosse et al., 2020).

However, the implementation of these globalisation and reshoring efforts is not without caveats, due to the complex and multi-layered global value chains that have developed in recent decades. Additionally, the issue of ensuring critical mass emerges in such a scenario,

in terms of both resources and also skilled labour force, as this is required to enable the smooth operation and functioning of the localised value chains. Moreover, the decoupling narrative proved to be problematic, often due to the lack of coordination, remanufacturing, and recycling, which ultimately means there is no decrease in production and, hence, no environmental benefits (Zink and Geyer, 2017).

McCann and Soete (2020) identify ‘smart specialisation strategies for sustainability’ (S4+) as the policies from the extensive EU portfolio most relevant to laying the ground of the Green Deal strategy. They define these as being established on local policy initiatives confronted differently with regional environmental issues, which have learned from their own RIS3 how to *‘motivate, induce, and coordinate entrepreneurship and learn from other regions confronted with similar challenges’*. In that respect, the Green Deal puts forward the importance of diversity within Europe, rather than scale: the impending realisation of the Green Deal and the New CE Action Plan will consequently rely on the acknowledgement of diversity in the local rather than national characteristics of the individual territories. This is an opportunity for Europe to generate value from diversity (Arsova et al., 2021).

3.2.3 Related findings

The diversity of situations varying from region to region, including the outermost regions, as well as the economic and social effects of the transition were highlighted as factors to be considered in order to have a fair and inclusive transition for all (supporting **Finding III** and **V** from **section 2.6**). The pioneering role of cities and regions in the transition and their function as hubs for circular change was also emphasised (supporting **Finding II** from **section 2.6**). In that context, the Council encouraged the Commission and MS to mobilise and support cities and regions to outline concrete action plans for CE transition and adopt different instruments on their disposal like policies, investment and pilot projects, innovation platforms to stimulate the private sector and encourage IS activities (supporting **Finding I, III, IV** and **V** from **section 2.6**).

The regional authorities, alongside local and national ones, were described as enablers of the transition in the CEAP, and the CE was stated to be one of the S3 priorities of the EU regions (supporting **Finding III** from **section 2.6**). The strong stakeholder’s engagement and a

systemic approach for the transition was characterised as vital to foster partnerships across sectors and value chains. In light of that, the establishment of the ECESP was considered crucial for bridging initiatives at different levels, acting as a meeting place for knowledge and experience exchange, multiplier of best practices but also scaling up effective solutions and addressing challenges (supporting **Finding IV** from **section 2.6**).

The S3 is perceived as a fundamental delivery mechanism on the EU sustainability agenda, and its place-based dynamics and directionality need can be of benefit to achieve a fundamental shift in policy and investment priorities. Finally, the **smart specialisation strategies for sustainability**’ (S4+) were pointed out as the most relevant policies for laying the ground of the Green Deal strategy and the implementation of the CE (supporting **Finding III** and **VI** from **section 2.6**).

3.3 Measuring CE implementation at a regional level

The need for metrics and indicators on the CE has been widely acknowledged by both academics and policymakers, but there is still insufficient work that can contribute to a deeper understanding and evaluation over time (Ghisellini et al., 2016). Policymakers need robust data and information in order to make well-informed decisions and support the implementation of the CE, which is in line with the principle that *“one cannot improve what is not measured”* (OECD, 2019). For that purpose, this section will focus on existing and proposed measurement systems for CE implementation, emerging from the grey literature.

According to Strat et al., (2018), the regional circular economies are the foundation stones of a functional global circular economy. In order to ensure worldwide implementation of the CE, national interrelated circular economies must be in place, but that can be constructed incrementally only if interconnected regional circular economies are established (see **Figure 28** for visual representation). The introduction of the CE-enabling policies will have a re-allocation effect, meaning the activities and competitiveness of the resource-intensive regions and sectors will be negatively impacted. Other sectors and regions that have the potential to thrive in a resource-efficient direction will benefit from this transition, and their activities and competitiveness will increase (OECD, 2017). These re-allocation effects will not only have economic implications for employment, GDP, investment, and public spending, but they will

also have accompanying social and environmental implications as well. Measuring the regional performance towards CE will guide local policy strategies and decision-making processes and it will help evaluate whether a region is heading in the right direction (OECD, 2019). Furthermore, by measuring the transition towards the CE on a smaller scale than the national, i.e., the regional, will enable going beyond the national average and indicate disparities within the country, but also show the front runners in this route – highlighting their best practices which can then be exemplars for the regions still catching up with the transition (Arsova et al., 2020).

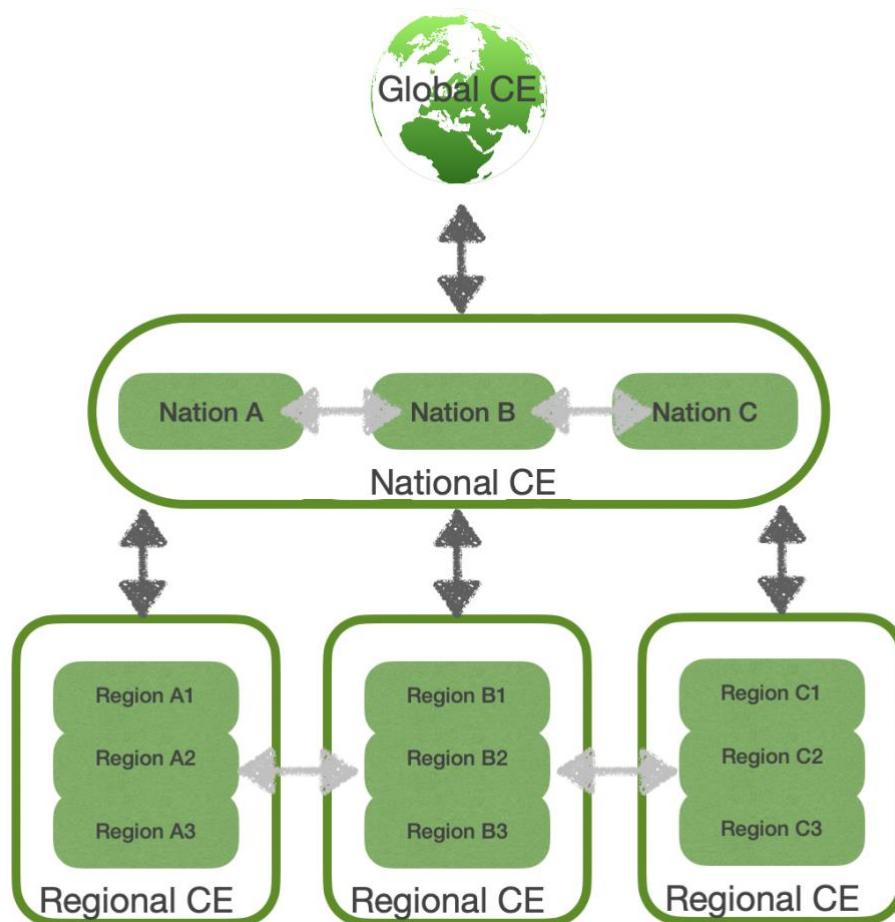


Figure 28: The importance of the regional circular economies and their interconnectedness – cascading upwards (**Source:** Arsova et al., 2020)

3.3.1 Regional measurement systems

Even though there has been progress in the development of measures, indicators, and frameworks for measuring the CE, there is still a knowledge shortage associated with regional indicators (Avdiushchenko et al., 2019; Virtanen et al., 2019). Additionally, to date, there is no

overarching methodology to compare the degree of transition of regions towards CE (Smol et al., 2017).

The OECD proposes a self-assessment scoreboard to evaluate the level of advancement towards a circular economy under the OECD Circular Economy Scoreboard for Cities and Regions. The ten key dimensions include: circular economy framework, co-ordination mechanisms, policy coherence, economy and finance, innovation, stakeholder engagement, capacity building, green public procurement, data, and information, and monitoring and evaluation. The cities and regions can assess the level of advancement based on the above dimensions to determine governance conditions to advance towards a circular economy. The self-assessment scoreboard is designed so that the regions and cities can identify gaps and set their own targets for improvement in the circular transition. In the policy recommendation and actions for a circular economy in Umea, Sweden (OECD, 2020), the OECD Scoreboard is again emphasised to evaluate the existing circular economy strategies in cities and regions. The OECD policy report suggests that a monitoring and evaluation framework for a circular economy strategy in cities and regions needs to be developed based on three key broad aspects: environmental (e.g., resources, waste and circulation processes), flows (e.g. water, energy, products, food, transportation, information, people) and social (e.g. number of circular jobs created) (OECD, 2020). Furthermore, the OECD is in the process of developing a set of tools to monitor the cities and regions' transition to a CE, aiming to launch a report in September 2020. The indicators included in the tool include key input, process and output indicators, and a scoreboard and a self-assessment tool to examine whether the government conditions in cities and regions are favourable towards the implementation of circular strategies (Arsova et al., 2020).

3.3.2 Measurement systems at other spatial scales

Taking into account that there is a lack of knowledge associated with the regional level specifically, other levels of implementation are also considered. Moraga et al. (2019) state that even though the three levels of CE implementation are defined as micro, meso and macro, the sub-levels within these three main levels are not generally agreed upon. More specifically, in the Chinese CE Promotion Law, regions are considered macro scale being situated between

cities and countries. However, according to Smol et al., (2017), regions are the linkage between macro and micro scales when evaluating CE eco-innovation, representing a meso scale. To overcome these dissimilarities in the treatment of regions, Moraga et al. (2019) propose that the micro, meso, and macro terminology should be followed by the precise array of analysis (i.e., consumer, product, service, business, technology, city, park, region, nation, continent, or globe).

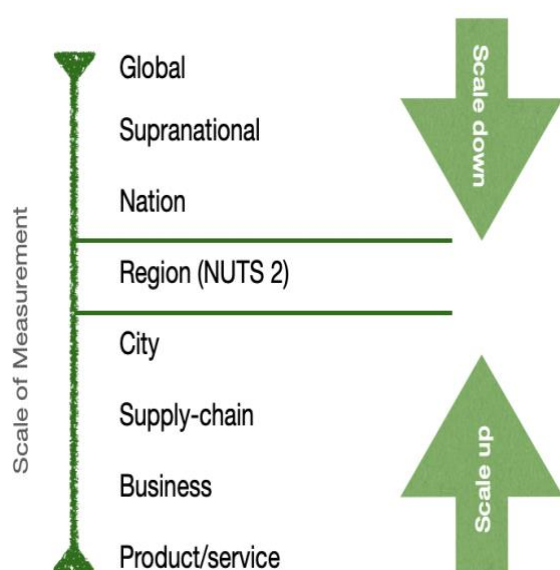


Figure 29: Scale of Measurement (**Source:** Arsova et al., 2020; **adapted from:** Moraga et al., 2019)

Their proposal has been adjusted based on the aim of this report (see **Figure 29**), hence measurement systems at other scales have also been considered. Measurement systems at larger scales than the regional scale was taken into account, with the rationale that they can be scaled down. In addition, smaller-scale measurement systems were reviewed given their potential to be scaled up and applied at the regional level.

3.3.3 Measurement systems with scaling down potential

The monitoring framework for the CE (MFCE) developed by the European Commission in 2018 is tracking the progress towards CE at the EU and country level. It has ten indicators grouped into four categories: production and consumption, waste management, secondary raw materials and competitiveness and innovation. However, these selected indicators are

mostly concerned with the EC's priorities on material self-sufficiency and recycling, overlooking the more transformative systemic and social dimensions of the CE concept. Hence, measurements linked to the use of energy, water, land, greenhouse gas emissions, environmental footprints, product lifespan, institutional drivers, and socio-economic implications of the shift towards CE, or the effect of activities associated with eco-design, reuse, and collaborative consumption, and sharing economy are currently absent from the MFCE. Additionally, not all data are available for every country or every indicator, which implies new data sources must be created and procedures for the gathering of new statistical data must be put in place. Another debatable trait is the elucidation of the data related to employment and CE activities. The association of CE solely with recycling, waste management, repair and reuse overlooks the impact of the whole productive system and neglects the importance of having circular design as the first priority. Furthermore, in order to evaluate the actual effect on employment related to CE activities, the net effect must be taken into account, along with the quality of the created jobs linked to CE activities (Llorente-Gonzalez and Vence, 2019).

The report from Think 2030 (2018) has also highlighted some recommendations for the MFCE. Namely, the use of Domestic Material Consumption² is not mirroring the material intensity of the economy, because imported resources are not factored into the equation. The comparison between Domestic Material Consumption with material footprint uncovers a large reliance of the EU on materials outside of Europe, which are not captured with this indicator. The funding at the EU level is transparent and clear, though this is not so obvious at member state or regional level. Finally, they are suggesting the inclusion of more reformist measures of socio-economic performance like the ones identified in the Beyond GDP initiative³, which could play a key role in breaking the link between development and unsustainable resource use, as well as providing a driver for economic transition.

The Directorate-General for Environment in the EC also launched a set of CE indicators to measure the performance in several areas that directly or indirectly contribute to CE development at country level. There are sixteen indicators grouped into three categories,

² Measures the amount of materials (excluding water and air) directly and actually used in a national economy

³ Initiative about developing indicators that are as clear and appealing as GDP, but more inclusive of environmental and social aspects of progress

looking at sustainable resource management, societal behaviour, and business operations (see **Table 23**). The issue with data availability is still evident even with this measurement attempt, since the period of the data for various indicators is different, and not all countries have all the data for each indicator.

Group	Indicator
Sustainable resource management	Material footprint (Domestic Material Consumption, t per capita)
	Resource productivity (Purchasing power standard per kg)
	Municipal solid waste – generation and recycling (kg per capita)
	Municipal waste recycled (kg per capita)
Societal behaviours	Citizens who have chosen alternatives to buying new products
	Coverage of the CE topic in electronic mass media and published articles
	Turnover in repair of computers and personal goods
	Number of enterprises and employment in repair of computers and personal and household goods
	Number of enterprises in repair of computers and personal and household goods (timeseries)
	Number of employees in repair of computers and personal and household goods (timeseries)
Business operations	Difficulties implementing CE activities experienced by companies
	Financing sources for CE activities
	Availability of information that can help to access finance for CE related activities, as reported by SMEs
	Share of enterprises that facilitated recycling of products after use
	Enterprises that extended product life through more durable products by innovation
	Enterprises that recycled waste, water or materials for own use or sale within enterprises by innovation

Table 23: CE Indicators by the European Commission (**Source:** European Commission - Directorate General Environment)

The POLITICO CE Index comprises of seven indicators, measuring circularity at the country level and ranking the EU Member States. The chosen indicators are municipal waste, food, waste, municipal recycling rate, share of goods traded that are recyclable raw materials, patents related to CE and investment in CE sectors. The data used for the rankings are taken from EUROSTAT and a report from the European Parliament (POLITICO, 2018). Another index at the national level is the 2018 Environmental Performance Index (EPI), comprised of 24 performance indicators covering environmental health and ecosystem vitality. The EPI, developed by Yale University and Columbia University in collaboration with the World Economic Forum, ranks 180 countries on environmental tendencies and development, providing the ground for effective policymaking (Wendling et al., 2019).

The EPI and the measurement systems, indexes and scoreboards/scorecards covered in the next paragraphs are not directly phrased as CE measurements. However, the areas of measurement they are covering are linked to the CE umbrella term, hence they are taken into consideration as ancillary CE measurements (**Figure 30**).

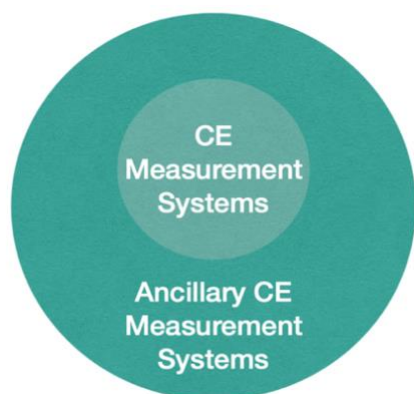


Figure 30: CE and Ancillary CE Measurement Systems (**Source:** Arsova et al., 2020; **adapted from:** Moraga et al., 2019)

Avdiushchenko et al., (2019) suggest that EU Scoreboards may be useful in the development of the measurement and monitoring system for CE. More precisely, the following scoreboards can be used as data sources:

- Resource Efficiency Scoreboard,
- Raw Materials Scoreboard,
- European Innovation Scoreboard,
- Regional Innovation Scoreboard,
- Digital Agenda Scoreboard,
- EU Transport Scoreboard,
- Consumer Conditions Scoreboard,
- Consumer Markets Scoreboard, and
- Social Scoreboard.

However, the level of the data collected and presented is at the EU and Member State level. Moreover, the Eco-Innovation Scoreboard (Eco-IS) and the Eco-Innovation Index are other valuable data sets that measure the eco-innovation performance within the EU Member States. There are sixteen indicators covering a range of five dimensions: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency and socio-economic outcomes. Even though the measurements are at country level, they provide a holistic view

on the economic, environmental, and social performance of the country (European Commission – Environment).

Additionally, specific indicators from the Regional Competitiveness Index (RCI) can be taken into account. RCI is measuring the key factors of competitiveness for all the NUTS 2 level regions across the EU, and it is updated every three years. The index evaluates, using over 70 comparable indicators, the ability of a region to offer an attractive and sustainable environment for companies and citizens to live and work. The RCI scorecards enable easy comparability among any EU region with a similar level of GDP per person. Being easy to use, users from different fields can see where their region is situated in the eleven RCI pillars: institutions, macroeconomic stability, infrastructure, health, basic education, higher education and lifelong living, labour market efficiency, market size, technological readiness, business sophistication and innovation (European Commission, 2019).

3.3.4 Measurement systems with scaling up potential

The Circular City Analysis Framework (CCAF) adopts a multi-sectorial and macro-meso level framework to establish and monitor goals for CE implementation in cities (Cavaleiro de Ferreira and Fuso-Nerini, 2019). It incorporates important CE conceptions like flexibility, modularity, and transparency, and gives an account of different agents involved in different sectors. Thirteen different sectors were identified and arranged into three categories: inner, intermediate, and outer circle. Each of the sectors had a set of indicators, 27 in total, and they were tested in the Porto region. Additionally, a goal was proposed for each of the indicators. The issue with data availability was also encountered at the city level.

The past research that has conducted a systemic review of existing circularity metrics and indicators have pointed out the lack of consistency and overabundance of circularity metrics (Pauliuk, 2018; Corona et al., 2019; Saidani et al., 2019). Saidani et al., (2019) conducted a systemic literature review of both academic and grey literature and identified 55 sets of circularity indicators featuring different purposes, scopes, and usages. In addition, the general consensus seems to be that the research on CE assessments and indicators is lacking, especially at the micro level. Elia et al. (2017) introduced a four-level framework to support the measurement of CE adoption. The four levels include the processes to monitor,

requirements to be measured, actions involved, and the implementation levels. Since the circular economy is a newly emerging paradigm, and the tools and criteria for measuring circularity of products, services, companies, or regions are lacking, the authors reviewing the circularity indicators and metrics analysed the usability of the existing assessment tools and measures to capture the level of adoption of circular strategies. Of the proposed framework, the systemic framework for guiding the assessment of a CE strategy suggested by Elia et al. (2017) as well as the systems approach emphasised by Pauliuk (2018) provide a scale-up potential to enrich the framework to evaluate circularity at a regional level.

Elia et al. (2017) evaluates several index-based methodologies to determine how appropriate they are for measuring circularity. The authors found that scientific literature adopts indicators that are limited to the resource use dimension at a micro level. The other important aspects of CE strategies, such as product durability, are not considered reflecting the resource-oriented characterisation of the CE concept. To overcome these limitations, Elia et al. (2017) introduce a systemic framework to assess the CE strategy at a product or a company-level. According to the authors, the assessment should begin with the identification of the system and process to analyse. For example, the assessment can cover a single process or the whole supply chain. In the second step, the CE activities that will have an impact need to be identified. The third step involves identifying CE requirements aligned with the selected CE activities and the last step is to choose an appropriate methodology to assess circularity of the CE strategies and their impacts on the environments. These four-step systemic approach illustrated by the authors can be further enhanced to guide the assessment of CE activities at a regional level. The regional initiatives can be identified, and their processes can be monitored. The CE requirements can be further classified based on the regional CE activities and combination of different methodologies can be chosen to provide a comprehensive assessment of circularity at a regional level.

Pauliuk (2018) provides a critical appraisal of a newly launched standard, “BS 8001 Framework for implementing the principles of the circular economy in organisations” by the British Standard Institution (BSI, 2017). Based on the critical appraisal, he acknowledges that the standard does not provide comprehensive and concrete guidance on monitoring CE strategy implementation. To fill this gap, the author proposes a systems approach to developing CE indicators. The systems approach proposed by Pauliuk (2018) illustrates the

possibility that the product and service-level indicators and existing assessment tools can be scaled up to develop CE assessment tools at a regional level when the regional system to monitor circularity is identified (Arsova et al., 2020).

3.3.5 Socio-institutional indicators

SUMMA CE Centre (2018) distinguishes between technology-related indicators and socio-institutional indicators. The former are evaluating the so-called hard parameters expressed in volumes like kg or environmental impacts, while the latter refer to governance and infrastructure aspects, such as what systems are in place for sharing, repairing or reusing products. What has been noticed is that most of the measurement systems at the regional level fall into the first category, focusing primarily on physical parameters since they are more easily evaluated; however, the issue of data availability is limiting those in some instances. The socio-institutional indicators are equally important but might not be easily ‘measurable’. As a result, they are less defined and therefore less commonly integrated in monitoring frameworks (Arsova et al., 2020). Some of the socio-institutional indicators suggested by SUMMA CE Centre are presented in **Table 24**.

Socio-institutional indicators
The degree to which collection, repair, reuse, and recycling infrastructure is in place.
Degree to which economic incentives, legislation or comparable rules are in place and enforced regarding product standards, standards for reused or recycled products/raw materials, waste management, better materials management
Degree to which business is involved in managing material cycles in a circular way and is empowered to make the right decisions, either on an obligatory or voluntary basis
Degree to which circular business models are adopted
Degree to which citizens are involved in managing material cycles in a circular way and are empowered to make the right decisions
Degree to which systems are in place for making more efficient use of resources, such as arrangements for sharing products or repairing and reusing them, exchange of information on availability of reusable or recyclable materials (for instance for enhancing industrial symbiosis)
Degree of information, education, and awareness about circular economy (integration into school and university curricula, public communication, and information campaigns)
Degree to which there are voluntary collaboration schemes in place encouraging value chain and cross-sectoral initiatives and information sharing;
The integration of circular aspects in public procurement schemes
Product standards related to the defined circular strategies

Table 24: Socio-institutional CE indicators (**Source:** SUMMA CE Centre, 2018)

3.3.6 *Related findings*

The benefits of measuring the regional performance towards CE were stated – guiding local policy strategies and decision-making processes, helping to assess whether a region is heading in the right direction, but also avail going beyond national average and pinpoint regional disparities within the country and show the frontrunners and the laggard regions (supporting **Finding VII** from **section 2.6**). The issue of data availability also emerged from the grey literature analysis (supporting **Finding VII** from **section 2.6**). Ancillary CE measurement systems were considered relevant and proposed to be used as potential starting point and source of data for regional CE measurement. Namely, the numerous EU Scorecards and well as the Eco-Innovation Index (on EU MS level) (aligned with **section 2.5.8**), but more importantly the Regional Competitiveness Index (RCI) reporting numerous dimensions on NUTS 2 level were suggested. Finally, some of the suggested Socio-institutional indicators from SUMMA CE Centre were deemed a valuable addition as potential dimensions to be included in forthcoming regional CE measurement systems – in order to address the underrepresented social aspects and institutional factors (supporting **Finding V** and **VII** from **section 2.6**).

3.4 Drivers and barriers for regional CE adoption

This section provides an overview of the incentives for CE and obstacles to implementation at the regional level, as outlined in the grey literature. The collected resources have been selected for their relevance; thus, all are discussing or analysing drivers and barriers encountered at regional level. The first section discusses the factors that could potentially foster the adoption of CE practices and thereby contribute to a greater level of circularity in a specific region. The drivers identified in previous studies are not only pertinent to one stakeholder group – on the contrary, but the list of drivers also concerns multiple groups of actors, including different levels of government, industry, academia, and civil society. The collected driving forces, presented in **section 3.4.1**, are more generic, related to general dynamics that can increase the circular activities in a specific region. Two sources were considered the primary contributors on the categorisation of the drivers, and these were the CIRCTER Policy Guide (2019) and the OECD Synthesis Report (2020).

The transition towards a CE at any level (including the regional) inevitably meets obstacles. Thus, it is crucial to identify the forces that the regions could leverage to potentially accelerate their circularity journeys. However, it is equally important (if not even more so), to identify the key barriers to CE implementation, as well as potential challenges that could arise in the future. Furthermore, it is not sufficient to simply identify them: one must also find a way to effectively address them, using the proper combination of incentives. For this purpose, the challenges faced by multiple regional actors in previous studies were collected and presented in **section 3.4.2**. Similarly, the collected barriers were also from a broader nature. Again, the CIRCTER Policy Guide (2019) and the OECD Synthesis Report (2020) were the primary sources used for developing these categories.

3.4.1 Catalysts for regional circular practices

The collected drivers from the desk review were synthesised into seven categories, presented in **Figure 31**. The categorisation of the drivers was primarily based on the grouping proposed in the CIRCTER Policy Guide (2019) and the OECD Synthesis Report (2020). The driver categories and specific subcategories are elaborated in the following sections.

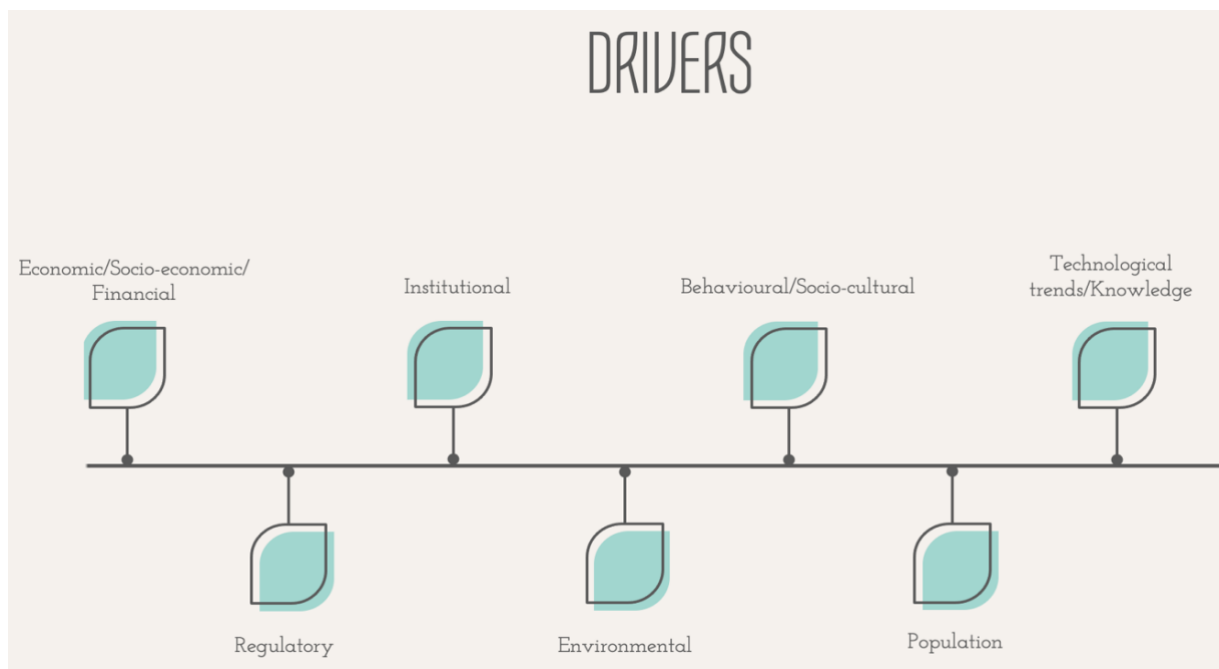


Figure 31: Categories of drivers for regional circular economy implementation (**Source:** Arsova et al., 2021b)

➤ Economic/Socio-economic/Financial

The CIRCTER Policy Guide (2019) suggests a number of economic drivers that can help a region to promote CE activities. These include economic savings, profit increases, new market or business opportunities, high prices for imported or raw materials, and attractive prices for circular products and services (CIRCTER, 2019).

The recent OECD Survey (2020) found that more than half (51%) of the surveyed cities and regions considered the changing economic conditions to be a major driving force towards the CE. As stated in the report (2020), *'the COVID-19 crisis has put the world on standby, unlike any other economic, social and climate crisis, resulting in a very significant GDP loss for 2020 (4.5%)'*. However, despite this, cities remain the apparatus of economic growth, and forecasts project that a group of 600 cities will generate almost 65% of the global economic growth by 2025 (McKinsey Global Institute, 2012).

In addition, as they grow in size, cities tend to create more income per capita (Bettencourt *et al.*, 2007); and while pursuing economic growth, resource efficiency tends to be improved, as denoted by the concept of 'decoupling' (OECD, 2020).

Recent evidence has shown a positive relationship between city size and income distribution, with income inequality tending to increase with city size. When cities are small, growth in size is desirable because it enables better economic performance. However, excessive growth of already large cities has negative consequences (Castells-Quintana *et al.*, 2020). Excessive city size can result in congestion diseconomies, which ultimately reduces economic performance (Frick and Rodriguez-Pose, 2018), and equally important, it can contribute to increased inequality and the threat of less cohesive societies (Castells-Quintana *et al.*, 2020).

Another important driver emphasised by the surveyed cities and regions is job creation (47%) (OECD, 2020). During the period of 2012 to 2018, the number of CE-related jobs in the EU increased by 5% to 4 million (EC, 2020). According to the ECa (2020), circularity is estimated to have a positive net effect on job creation, assuming that staff are trained accordingly and possess the specific skills needed for the green transition. Additional jobs emerge because the CE supports repair, maintenance, upgrading, remanufacturing, reuse, recycling of materials, and product-life extension, which are more labour-intensive than the mining and

manufacturing of a linear economy (Wijkman and Skånberg, 2017). However, the transition must also consider the wellbeing of society, life quality, and equity (OECD, 2020).

➤ Regulatory

Regulatory drivers are very closely linked to economic incentives and taxation systems. The CIRCTER Policy Guide (2019) suggests a number of regulatory drivers that can help a region to encourage CE activities. These include the existence of charges, taxes on unsustainable and harmful activities, high charges for waste and high landfill taxes, tax benefits for green activities, and bans of specific products (e.g., single-use plastic) (CIRCTER, 2019).

➤ Institutional

More than half (52%) of surveyed cities and regions cited global agendas as propelling forces of CE implementation (OECD Survey, 2020). The CE approach contributes to the attainment of the 2030 Agenda for Sustainable Development, directly associated with SDG12 (*Sustainable and responsible consumption and production patterns*), while other SDGs (6, 7, 15) are also deemed important for increasing sustainability in cities (SDG 11). Moreover, the CE supports the Paris Agreement under the UNFCCC, as circular practices not only reduce greenhouse-gas (GHG) emissions but also tackle issues related to natural-resources extraction and exploitation. Finally, the CE contributes to the implementation of the New Urban Agenda (2016), the EU Green Deal, and the G20 initiatives on resource efficiency (OECD, 2020).

National and supranational legal frameworks provide a significant impetus towards the CE for 40% of the surveyed cities and regions (OECD, 2020). The most vital supranational legal frameworks include ‘the European Circular Economy Package’ and ‘the New Circular Economy Action Plan’, while examples of national legal frameworks include ‘the Federal Roadmap for a Circular Economy’, Belgium (2016); ‘the Strategy for Circular Economy’, Denmark (2018); ‘Leading the Cycle – the Finnish Road Map to a Circular Economy 2016-2025’ (2016); ‘the Finnish Road Map to a Circular Economy 2.0’ (2019); ‘Circular Economy and Bioeconomy Strategy’, Finland (2017); ‘the Circular Economy Roadmap of France: 50 Measures for a 100% Circular Economy’ (2018); ‘Towards a Model of Circular Economy for Italy: Overview and Strategic Framework’ (2017); ‘A Circular Economy in the Netherlands by 2050’ (2016); ‘The Roadmap Towards the Circular Economy in Slovenia’ (2018); ‘the Spanish

Strategy for Circular Economy: España Circular 2030' (2020); and 'Circular Economy – Strategy for change in Sweden' (2020).

Additionally, civil society circular initiatives (31%) and private-sector circular initiatives (46%) stimulate the transition in the regions (OECD, 2020). Numerous international organisations, umbrella organisations, and foundations encourage cities and regions in their CE journeys, with business and citizen initiatives such as the Ellen MacArthur Foundation, C40, Climate KIC, ICLEI, and the European Investment Bank. Several bottom-up initiatives motivate governmental actions in the surveyed regions. For instance, in the region of Lapland,⁴ CE practices commenced as a business-sector initiative in 2012. The industrial sector (bio-forest, forestry, mining, and steel) requested support from the public authorities related to the reuse of by-products and residues to promote the competitiveness of the industry associated to the regions' resilience. Local authorities welcomed the appeal, opening a dialogue about CE, providing technical assistance, and promoting collaborations (OECD, 2020).

➤ Environmental

The OECD report on CE in cities and regions reveals that climate change is perceived as a CE driver by 73% of the surveyed cities and regions (OECD Survey, 2020). To achieve the objectives of the Paris Agreement and limit global warming to less than 2 °C and 1.5 °C by 2030, emissions must be 25% and 55% lower than in 2018, respectively (UNEP, 2019). In light of that, the EU Green Deal framework sets the goal of achieving a climate neutral economy by 2050. Moreover, with the 2030 Climate and Energy Framework, the EU aims for 32% usage of renewable energy and 32.5% improvement in energy efficiency for the period of 2021 to 2030 (ECb, 2020). Cities and regions are a large part of the resolution, as most environmental and climate-related spending occurs at the subnational level. The transition towards a CE is growing in importance in connotation with investments outlooks and necessary infrastructure. More than 50% of the urban infrastructure that will exist in 2050 is yet to be constructed, and the manner in which this infrastructure is planned and built will affect how people travel, buildings are constructed, and materials are repurposed, with the ultimate goal of decreasing the use of fossil fuels (OECD, 2020). In the period of 2000 to 2016, subnational governments in 30 OECD countries were accountable for an average of 55% of environmental

⁴ The Finish region of Lapland is classified as a NUTS3 region.

and climate-related spending (OECD, 2019). Nonetheless, climate-related investment accounted for only 0.4% of their gross domestic product (GDP) within the same period (OECD, 2020).

To achieve low-carbon economies, governments must encourage more efficient use of resources, taking into account natural-resources availability, sustainable consumption, and production trends, while supporting CE to retain the highest possible value of goods and products, avert waste generation, and reuse and convert waste into resources (OECDa, 2020).

➤ Behavioural/Socio-cultural

High consumer awareness, a strong Corporate Social Responsibility (CSR) culture, and strong entrepreneurial culture are some of the suggested behavioural and socio-cultural drivers that can help a region to foster its CE transition (CIRCTER, 2019).

Increased awareness among wider society and policymakers regarding the vital function of CE in delivering smart, sustainable, and inclusive growth, as stressed in the Europe 2020 Strategy (COM no. 130, 2014), is a primary driving force of the CE shift. All stakeholders (government, academic, industry, and citizens) partaking in CE activities (Carayannis and Campbell, 2012), plus citizens and their awareness and conduct, all have a vital role in putting CE notions into practice (Smol *et al.*, 2018). According to Elia *et al.* (2017), CE is a novel concept in Europe, therefore it is vital to observe and assess public awareness because a profound ecological culture and societal awareness are essential for creating a responsible CE society (Smol *et al.*, 2018). Specifically, efforts should be directed towards awareness among the youth, as their knowledge, attitudes, and consumption behaviours are instrumental for building a CE-oriented society with long-term benefits (Kanchanapibul *et al.*, 2014).

Today, most research on CE awareness is conducted in China (e.g., Xue *et al.*, 2010; Liu *et al.*, 2009; Liu and Bai, 2014; and Guo *et al.*, 2017), where CE has been a national development strategy since 2009. Zeng *et al.* (2017) report increasing public and business awareness of CE, compared to 2008, when the first study of CE awareness was conducted. In the EU, the EC began to conduct CE-oriented research to explore CE-related industry enticements (Flash Eurobarometer, 2016), but few studies have investigated public awareness of the CE on the EU scale (Lakatos *et al.*, 2016), and no research has been dedicated to youth awareness (Smol *et al.*, 2018).

➤ Population

A growing population and higher living standards increase waste-production levels and the consumption of natural resources. It is forecasted that the global population will reach 9 billion by 2050, and more than half (55%) will be living in cities (OECD/EC, 2020). This projected demographic change and urbanisation will entail a substantial enlargement of existing cities, as well as the construction of new ones (UNEP, 2018). The consequences will include increased use of biomass, metals, non-metallic materials, and fossil fuels to meet the food, housing, energy, and infrastructure needs (OECD, 2020). Crucial areas of the CE – such as waste-management, energy, and material consumption – are conditional on population density, since more densely populated countries consume fewer materials.

Regarding local and regional arrangements, carbon emissions are closely linked to urban density and structure, as more compact cities and regions can contribute to reducing GHG emissions by reducing the need for construction of new roads, sewers, water lines, and other infrastructure (Ellen MacArthur Foundation, 2019; UNEP, 2018). In this context, Morikawa (2012) established a positive relationship between energy-consumption efficiency and population density. Urban density, moreover, has an important role in the waste sector, because low population density can be a restraining factor on recycling rates, due to the higher costs of waste-collection and transportation in less populated areas (OECD, 2020). Nevertheless, high population density can be a ‘double-edged sword’, since it requires a more efficient waste-management system due to sanitation problems and the scarcity and cost of land (Montevecchi and Reisinger, 2014; Matsunaga and Themelis, 2002).

➤ Technological trends/Knowledge/Capacity

Qualified staff and research and innovation (R&I) capabilities, along with availability of and access to innovation and testing facilities are among the technology-related drivers that can aid a region’s transition toward CE (CIRCTER, 2019). Additionally, the OECD survey revealed that new business models (43%), technical developments (43%), and research and development (R&D; 41%) are regarded as driving forces by more than 40% of the surveyed cities and regions (OECD, 2020). New business models – ranging from reverse logistics, reuse, leasing, and sharing – are thriving, alongside an increase in practices related to green infrastructure and decoupling alternatives, such as electric vehicles, solar panels, smart grids,

retrofitting of buildings, and recycling facilities. Furthermore, cities and regions are increasingly hosting industrial symbiosis processes and clusters, on the understanding that the waste of one is input for another (OECD, 2020).

3.4.2 Inhibitors of regional circular practices

The barriers collected from the desk review were synthesised into five categories, presented in **Figure 32**. The categorisation of the drivers was largely taken from the grouping proposed in the two reports, the CIRCTER Policy Guide (2019) and the OECD Synthesis Report (2020). The barrier categories and specific subcategories are elaborated in the following subsections.

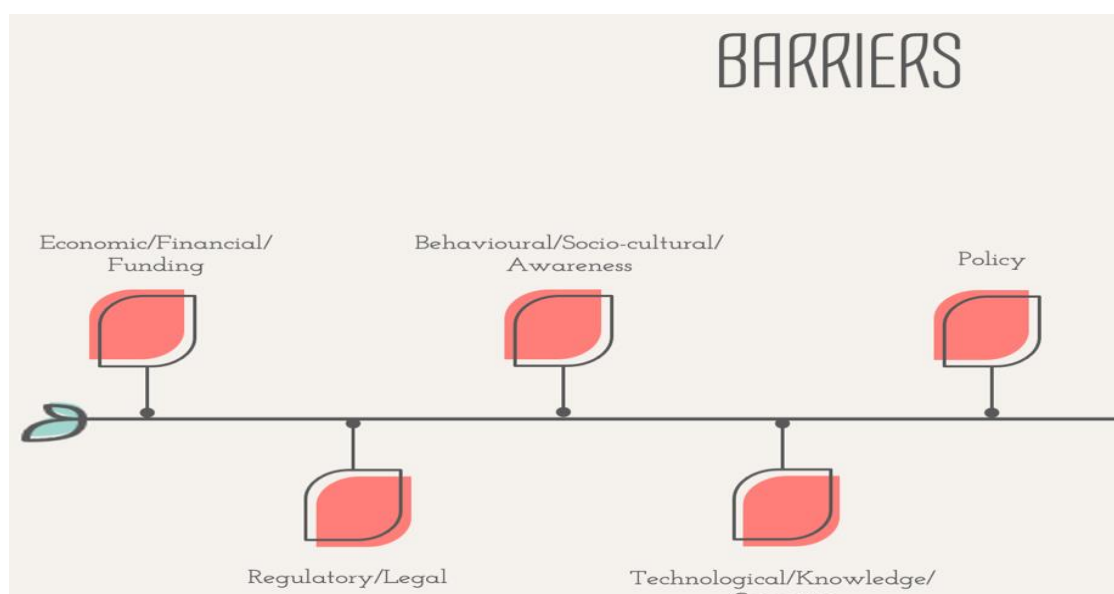


Figure 32: Categories of barriers for regional circular economy implementation (Source: Arsova et al., 2021b)

Economic/Financial/Funding

The economic/financial/funding category of barriers is the widest and more frequently mentioned. CIRCTER (2019) provides examples of economic challenges that regions can face, such as limited or the absence of returns from investment, limited markets for recycled products, and a lack of funding and investment sources for CE businesses and initiatives.

In light of this, the OECD (2020) claims that the CE shift necessitates investment and appropriate incentives to support the economic and financial case for the CE. The surveyed cities and regions responded that they face constraints as a result of the funding gaps, including insufficient financial resources (73%), financial risk (69%), lack of critical scale for business and investment (59%), and lack of private-sector engagement (43%). Moving towards

an economy that is more circular will entail a substantial amount of investment, but investment gaps are reported and typically bridged by public funds, such as taxes and subsidies (OECD, 2020). Circular initiatives and pilot projects are recorded but scaling them up is usually complex because of the restricted access to additional financial resources. Additionally, the shift towards a CE creates financial risks for the economic actors, partly due to the scale of the activities taking place in cities of different sizes, due to market size, population, material flow, and so on (OECD, 2020). Moreover, the inclusion of well-known, big industry players as accelerating agents for the transition is needed. The NUTS1 region of Flanders, for instance, emphasises the need for funding projects that cover the entire product or value chain (OECD, 2020).

➤ Regulatory/Legal

A substantial number of the collected barriers belong in the regulatory or legal category, affirming the vital role of regulation in the transition. CIRCTER (2019) lists, as regulatory barriers faced by some regions, the subsidies for traditional polluting or inefficient activities (e.g., coal, water, and energy costs) and rigid 'end-of-waste' criteria to prevent repurposing of waste streams for recycling, reuse, remanufacturing.

In the regulatory category of challenges faced by regions and cities, the OECD (2020) notes the inadequate regulatory framework (73%) and incoherent regulation across levels of government (55%). The surveyed cities and regions argue that the regulatory framework needs to be established and adapted to unlock the full potential of the region for the circularity journey. Uncertainty regarding waste-stream classification was reported by numerous stakeholders, along with the need to clarify how materials can be reintegrated into the manufacture process when they are still reusable but qualified by law as waste. In that respect, they claim that one of the largest hindrances to the implementation of the CE is the current definition of 'waste' in national legislation. The existing EU directive for eco-design concentrates on areas linked to energy and partially disregards the materials and typology of products in a wider outlook (OECD, 2020).

➤ Behavioural/Socio-cultural/Awareness

Lack of awareness is one of the most frequently encountered barriers to the regional advance in the circular direction, as shown by the analysed contributions in this report. More than half

of respondents (63%) of the OECD survey cited lack of awareness as a challenge they are facing (OECD, 2020). CIRCTER (2019) points to an old-fashioned mindset in companies and among leadership and a lack of entrepreneurial spirit, describing these as additional challenges for transitioning regions.

Other awareness gaps indicated by the OECD Survey (2020) include cultural barriers (67%) and inadequate information (55%); and this inhibits the ability of policymakers to make decisions, businesses to innovate, and citizens to embrace sustainable consumption practices. Some CE-related behaviours – such as reuse – are rarely regarded as valuable alternatives for reducing consumption and waste generation. The persisting acceptance issue is partly due to a lack of awareness, as well as a lack of trust in the quality of the reused products. To that end, many cities and regions have developed systems of quality certification, such as the ‘Revolve Re-use’ programme from Zero Waste Scotland that establishes reuse quality standards for reuse shops, awarding a specific logo distinguishable by consumers (OECD, 2020).

➤ Technological/Knowledge/Capacity

Several barriers related to technology and knowledge are also acknowledged in the CIRCTER Policy Guide (2019), such as a lack of experts in areas related to regional CE, limited R&I capabilities in companies and universities, and poor-quality or lack of research, testing, and piloting infrastructure. Two capacity gaps were identified by the OECD (2020), with the lack of human resources and of technical solutions posing a challenge for 61% and 39%, respectively, of the surveyed cities and regions. There are certain capacities that are essential for a region that wishes to progress towards a more CE (OECD, 2020).

➤ Policy

The systemic nature of the CE is due to the variety of stakeholders, sectors, and goals involved in the process. This entails a wide policy focus through policy integration of silo strategies (OECD, 2020). As stated by the OECD (2020), *‘when interactions and complementarities are overlooked, the lack of a systemic approach might lead to the implementation of fragmented projects in the short to medium run, rather than sustainable policies in the long run’*.

In many instances, the CE debate is concerned with enabling niche, techno-economic experimentation, while discussions around more socio-economic agendas are less frequent (Genovese and Pansera, 2020). These fragmented efforts and silo policy approaches can be

somewhat avoided by adopting a more holistic view. However, one barrier highlighted by the surveyed regions and cities is a lack of holistic vision (cited by 67% of the respondents), which in turn could be the result of poor leadership and coordination (OECD, 2020). The responsibility for devising CE strategies and putting them into practice amongst the city administration is sometimes unclear, which leads to fragmented initiatives and weak accountability. On many occasions, the specific mandate for setting and executing long-term CE visions has been assigned to waste-management or environmental departments, another time circumventing the multi-dimensional aspect of the CE. Numerous sections partake in CE-related undertakings, hence stronger coordination is required. Other policy gap identified was around the lack of political will (39%; OECD, 2020).

3.5 Regional Strategies Analysis: Key drivers and barriers for CE implementation

Section 3.4 provided an overview of the drivers and barriers associated with implementation of CE at the regional level, as presented in the grey literature. To verify and complement these findings, a preliminary secondary data analysis was conducted for selected EU regional strategies and action plans for CE transition, as well as the existing S3 for those regions. The analytical results are presented in the next sections.

3.5.1 Selection strategy and process

As the NUTS2 regions have been proposed as the optimal level for CE implementation (**section 1.1** and **2.5.2**) the 242 NUTS 2 EU regions were the starting point for selection of the regional strategies analysed in the following sections. The flow chart presented (**Figure 33**) illustrates the selection strategy and process of the regions and their S3 and CE strategies. As explained in **Box 4**, the NUTS 2 regions belong to three development categories. The first selection criterion was to include regions from all categories to ensure representativeness and minimise the possibility of presenting biased and distorted representations of the status of the CE efforts across the EU regions. Additionally, an attempt was made to delve into an intercountry case and select regions with CE strategies from the three development categories and compare them. For that purpose, three Spanish regions were included in the analysis,

having been chosen on the basis of the online availability of data and the authors' knowledge of the Spanish language.

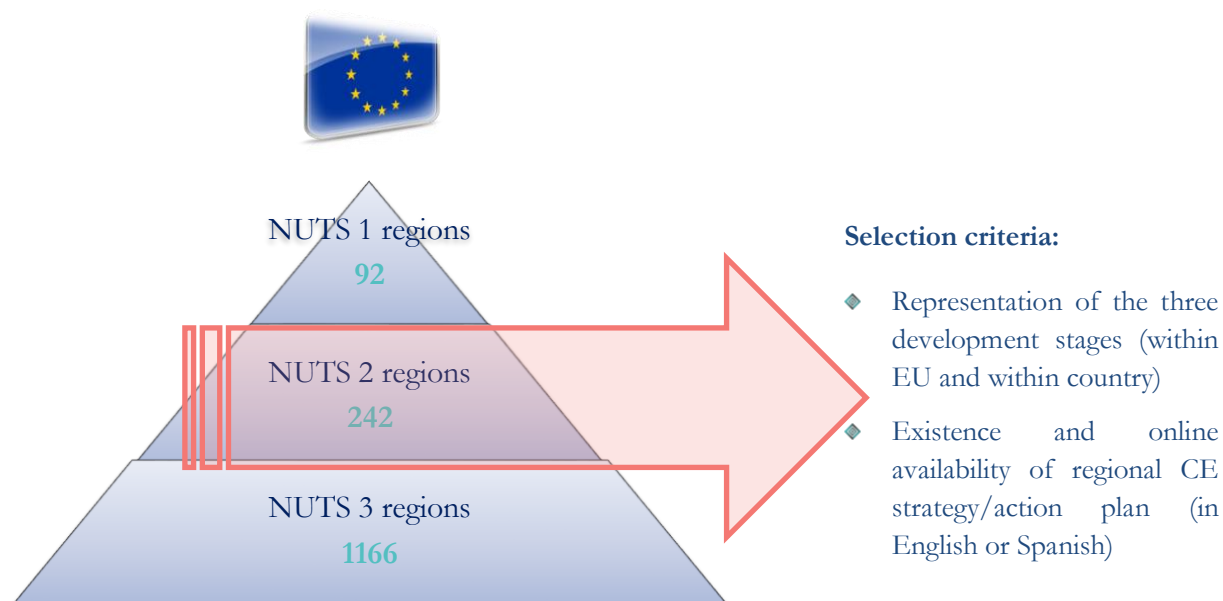


Figure 33: Selection strategy and process - regions according to NUTS 2021 (**Source:** Eurostat Regional Yearbook, 2022)

The next step of the selection process was to identify regions that had CE strategies in place that are available online and written in English or Spanish. Regions in the more developed regions category had the greatest representation, as a large proportion had strategies and action plans in place. Difficulties arose, however, when trying to identify less developed and transitioning regions that had a strategy for CE implementation available online. These regions tended to lack a national policy framework or action plan for the CE, as was the case for Bulgaria,⁵ Cyprus,⁶ Estonia,⁷ and Hungary.⁸ On the other hand, Nordic countries ranked highly for their pro-environmental initiatives and seem to be focusing their efforts on achieving circularity in their smaller territories, more particularly their NUTS 3 regions. As reported in the OECD Synthesis report (2020), the regions of North Karelia, South Karelia, and

⁵ <https://www.interregeurope.eu/reduces/news/news-article/10186/bulgaria-on-its-journey-to-circular-economy/>

⁶ https://switchmed.eu/wp-content/uploads/2021/02/Country-Profile-Cyprus_final.pdf

⁷ <https://ringmajandus.envir.ee/index.php/en/creating-strategy-and-action-plan-circular-economy-estonia>

⁸ <https://www.oecd-ilibrary.org/sites/9789264298613-11-en/index.html?itemId=/content/component/9789264298613-11-en>

Southwest Finland have developed actions plans for the NUTS 3 level regions, but they were excluded from the analysis in this report. The selected regions, with their regional CE strategies and respective S3 are shown in **Table 25**.

Box 4: The NUTS 2 regions

The NUTS classification provides the basis for regional boundaries and geographic eligibility, as statistics from regional accounts are used for the allocation of EU funds. For the 2021–2027 period, the allocation of funds uses a method that remains largely based on regional gross domestic product (GDP) per inhabitant but also adding a set of new criteria (e.g., youth unemployment, low education levels, climate change, and the reception and integration of migrants), to better reflect the challenges faced by each region. For the period 2021–2027, eligibility for cohesion funds is based on NUTS level 2 regions being ranked and split into three groups:

- less developed regions, where GDP per inhabitant was less than 75 % of the EU average;
- transition regions, where GDP per inhabitant was 75 %–100 % of the EU average; and
- more developed regions, where GDP per inhabitant was more than 100 % of the EU average (Eurostat Regional Yearbook, 2022).

	Country	Region	GDP per inhabitant ⁹	Regional CE Policy/Strategy	S3/RIS3 Strategy
More developed regions		Luxembourg	263%	Circular Economy Strategy Luxembourg (2021)	Research and Innovation Smart Specialisation Strategy (RIS 3) (2017)
		Brussels Capital Region	205%	Brussels Regional Program for a Circular Economy 2016 – 2020 (BRPCE) (2016)	Regional Innovation Plan 2021–2027 (including the new RIS3) (2021)
		Central (Jutland) Denmark Region	124%	Sustainability Strategy 2030 for Central Denmark Region (2021)	Region Central Jutland's Development Strategy 2019-2030 (2019)
Transition regions		Catalonia	99%	Strategy to promote the green economy and the circular economy (2015)	Research and Innovation Strategy for the Smart Specialisation of Catalonia RIS3CAT (2014-2020) (2014)
		Friesland	93%	Circulair Fryslân: De Economie Van De Toekomst (2015)	RIS3 Northern Netherlands 2021-2027 (2021)
		Galicia	78%	Galician Circular Economy Strategy 2020-2030 (2019)	Smart Specialisation Strategy of Galicia (2014-2020) (2014)
Less developed regions		Extremadura	65%	Extremadura 2030: Strategy for green and circular economy (2017)	RIS3 Extremadura 2027 (2021)
		Region of Central Macedonia	49%	Action Plan: Towards Bio-Based Circular Economy (2019)	Research and Innovation Strategy for Smart Specialisation (RIS3) 2014-2020 (2015)

Table 25: Selected NUTS 2 regions with regional CE initiatives and S3 for analysis

⁹ GDP per inhabitant in PPS (% of the EU-27 average), 2020 available here: <https://ec.europa.eu/eurostat/web/regions/statistics-illustrated>

3.5.2 Regional Blueprints

This section presents the so-called blueprint of the selected regions, showing the profile of the region and its respective CE policy documents. The name of the region and its NUTS code is given first, followed by its population and stage of development; all the information has been extracted from the European Social Progress Index 2020 (2020 EU-SPI) Scorecards.¹⁰ In **Table 25**, the GDP per inhabitant in PPS is introduced; and based on this, the regions are categorised as more developed, transitional, or less developed. As such, no other economic indicator is presented in this section. An effort was made to identify NUTS 2 regional indicators and measures to represent a broader perspective of the regions' status, giving an overview of the social and environmental dimensions. For that purpose, two sources were included in the Regions' Blueprints.

First, the European Social Progress Index 2020 (2020 EU-SPI) is incorporated as a measure of societal development and quality of life at the regional level, going beyond GDP. The index measures social progress in European regions, at the NUTS-2 level, using 12 components described by a total number of 55 comparable social and environmental indicators, excluding economic aspects. The components are further aggregated into three broader dimensions of basic human needs (necessary enablers of societal development), foundations of wellbeing (intermediate factors of social and environmental progress), and opportunities (the most advanced component of a cohesive and tolerant society). The higher the score of the region, the better its rank within the 240 EU NUTS-2 regions.

The OECD Regional Wellbeing¹¹ measure is then presented. Each OECD region is measured on 11 scales important for wellbeing – including the environment. The values of the indicators are expressed as a score between 0 and 10. A high score indicates better performance relative to the other regions.

To further complement the picture of the institutional and fiscal decentralisation of EU countries, the Division of Powers¹² was added to the Regions' Blueprints, showing the legal

¹⁰ https://ec.europa.eu/regional_policy/en/information/maps/social_progress2020/#3

¹¹ <https://www.oecdregionalwellbeing.org/>

¹² <https://portal.cor.europa.eu/divisionpowers/Pages/default.aspx>

bases for the various governance structures in the respective countries, the responsibilities and powers of the regions, and their respective regional authorities.

Afterwards, the national and regional frameworks are presented, along with the specific CE action plans or strategies for the regions. Relevant information has been extracted from the policy documents, focusing primarily on the cited or implied drivers, incentives, and challenges and barriers faced by the region in its journey towards the CE.

As already elaborated in **section 3.2.2**, the S3 appear as very relevant mechanisms which will enable the EU regions to transition towards a more circular future. For that reason, an effort was made to include some preliminary information regarding the existing S3 of the studied regions, with some key information. This enabled to perform a preliminary analysis of the S3, but more importantly to uncover the links between S3 and the regional CE policies.



LUXEMBOURG (LU00)

Population	Stage of development (1=Lowest; 5=Highest)
602 000	5

2020 EU-Social Progress Index (SPI)

Score (0-100)	74.6
Rank	42/240
EU score (0-100)	66.7

OECD Regional Wellbeing (0-10)

Education	7.3
Jobs	7.0
Income	6.8
Safety	9.4
Health	8.5
Environment	6.0
Civic engagement	10.0
Access to services	9.9
Housing	6.1
Community	6.2
Life satisfaction	6.7

Division of powers – Luxembourg

Member state without legislative powers at the sub-national level – unitary state. Representing NUTS 1, NUTS 2, and NUTS 3 regions.

Central level (state responsibilities): Exclusive legislative and administrative powers in all fields related to national interest.

Regional level: District commissioners ensured compliance with laws and general and municipal regulation.

EU frameworks: New Circular Economy Action Plan (2020).

National frameworks: Luxembourg 'Null Offall' (Zero Waste) strategy (2020), Data-Driven Innovation Strategy (2019).

Regional CE Strategy: Circular Economy Strategy – Luxembourg (2021) (national and regional strategy).

Responsible institution: Major public stakeholders for implementing CE are both at level of state, with its ministries, administrations, and agencies, and at municipal level.

Vision: Luxembourg will be the first circular nation, where

new business models based on the product as a service principle become standard.

Circular tools: regulatory framework, financial framework, knowledge creation and management.

Drivers: At the national level, the main drivers of the strategy are the ministries and administrations dealing with the management of the economy, the financial framework, spatial planning, resource management, climate action, environmental protection etc. At a practical level, all public projects should be founded on circularity principles, so that all initiatives it can become an enabler and a driver for the transition. As for the governance of the strategy, setting up a permanent consultation and coordination process is amongst the key drivers of the CE in Luxembourg. Additionally, as key drivers are listed the following institutions: Ministry of Energy and Spatial Planning, the Ministry of the Economy, the Ministry of the Environment, Climate and Sustainable Development (MECDD) and the Ministry of Finance, but also the Ministries of Mobility and Public Works, Housing and Agriculture. The Luxembourg's integrated ecosystem was considered to be an important enabler of the CE implementation, as well as the Information and Communication Technologies (ICT).

Challenges: Regulatory, financial, organisational.

RIS3/S3: Research and Innovation Smart Specialisation Strategy (RIS3) (2017) – In 2013 ecotechnologies was one of the main identified priority economic sectors, and CE was its subsector. In 2017, the key economic sectors were reframed, and the six newly selected economic sectors were operating within the CE perspective. For the RIS3 in 2017, four out of these six economic sectors were chosen, and again they were operating within the CE perspective.



BRUSSELS CAPITAL REGION (BE10)

Population	Stage of development (1=Lowest; 5=Highest)
1 207 000	5

2020 EU-Social Progress Index (SPI)

Score (0-100)	68.5
Rank	123/240
EU score (0-100)	66.7

OECD Regional Wellbeing (0-10)

Education	7.1
Jobs	2.9
Income	3.8
Safety	7.8
Health	6.9
Environment	5.1
Civic engagement	10.0
Access to services	7.8
Housing	6.7
Community	7.3
Life satisfaction	6.3

Division of powers – Belgium

Member state with legislative powers at the sub-national level – complex federal state.

Regional level: Has legislative and executive organs known as the **regional parliament** and the **regional government**. Regions have legislative powers in fields connected to their territory and, therefore, may issue regional decrees that have the force of law. No hierarchical relationship between the regions and the federal authority, and their powers have shared responsibilities in some areas (i.e., environment, taxation, energy, etc.).

Regional CE strategy: Brussels Regional Program for a CE (BRPCE) 2016-2020 (2016).

General objectives: (i) To transform environmental objectives into economic opportunities; (ii) to relocate the economy to Brussels to produce locally whenever possible, reduce travel, optimise land use, and create added value for Brussels inhabitants; and (iii) to help create employment.

Steering of the BRPCE: Three Ministers (**Minister for Housing, Quality of Life, the Environment and Energy; Minister for the Economy, Employment and Vocational Training; Secretary of State Responsible for Public Cleanliness, the Collection and Treatment of Waste, and Scientific Research**), four regional administrative bodies (**Impulse – the Brussels Enterprise Agency, Brussels Environment – the Brussels administration for the Environment and Energy, Bruxelles-Propreté Agency – the Brussels Agency for Urban Cleaning, and the Collection and Treatment of Household Waste, Innoviris – the Brussels administration for the promotion and support of innovation**) and other stakeholders.

Drivers: Combining bottom-up and top-down approaches – involving multiple public and private stakeholders in the origination, operation, and reporting of the measures; cross-functional measures (favourable regulatory framework); sector-based measures (target construction, resources and waste logistics, trade and food sectors); territorial measures (integrating the CE at the local level); governance measures (strengthening coordination between authorities); BRPCE, designed as a ‘living strategy’ and being revised every 18 months;

Challenges: Incorporation of bottom-up and top-down approaches creates the greatest challenges; working efficiently in a multi-administration and co-creative manner, with production facilities located outside the region.

RIS3/S3: Regional Innovation Plan 2021–2027 (including the new RIS3) (2021) – For the Brussels Capital Region, RIS3 is also the basis for the Regional Innovation Plan, and on the basis of its RIS3 the Region’s priority is to improve resilience and prosperity of the Brussels economy (sustainability, quality jobs, well-being of citizens).



CENTRAL (JUTLAND) DENMARK REGION (DK04)

Population	Stage of development (1=Lowest; 5=Highest)
1 313 000	5

2020 EU-Social Progress Index (SPI)

Score (0-100)	82.8
Rank	6/240
EU score (0-100)	66.7

OECD Regional Wellbeing (0-10)

Education	7.1
Jobs	8.5
Income	3.8
Safety	9.8
Health	7.1
Environment	7.6
Civic engagement	9.2
Access to services	9.1
Housing	5.0
Community	10.0
Life satisfaction	9.3

Division of powers - Denmark

Member state without legislative powers at the sub-national level – unitary state organised on a decentralised basis.

Central level (state responsibilities): general legislative powers in the area of national sovereignty.

Regional level: Regions have responsibilities in the area of regional development, environment and nature, soil pollution, among the rest. No hierarchy between the regions and the municipalities.

International framework: UN Sustainable Development Goals

Regional CE Strategy: Sustainability Strategy 2030 for Central Denmark Region (2021).

Responsible institution: Central Denmark Region – Regional Council

Overall regional climate goals: CO2 neutral operations within energy and transport by 2030; 67% reduction of the total carbon footprint from 2018 to 2030 (including goods and

services); 96% reduction of the total carbon footprint from 1990 to 2030 (excluding goods and services); CO2 neutral circular region by 2050.

General vision: In 2030, we intend to be a circular region with sustainable procurement, reuse, recycling, renewable energy, and minimal consumption. In 2050, we intend to be CO2 neutral.

General mission: We integrate sustainability in the core of Central Denmark Region investments, services, and daily operations. The green transition creates value and becomes a significant driver of the development of our region to the benefit of citizens and employees.

Four focus areas of the strategy: 1) circular economy; 2) electricity water and heating; 3) logistics, transport, and mobility; 4) social responsibility.

CE (as one of the four focus areas of the strategy) goals by 2030: 30% reduction in use of resources in procurement and daily operations; 30% reduction in waste; 70% recycling of waste.

RIS3/S3: Region Central Jutland's Development Strategy 2019-2030 (2019) – the region has approached S3 predominantly as set of criteria to be fulfilled in order to obtain EU funding for regional development programmes. Hence, the Danish ecosystem is based on bottom-up industry involvement when formulating and revising development strategies - principles which are also central to the S3 framework. The regional development strategy doesn't entail a particular S3 feature, and the core areas are not designated as competitive advantages. However, the Danish regional development frameworks are treated as S3 equivalent and therefore continue to get allocated EU fundings without any restructuring of the programmes (Nordregio Policy Brief, 2019).



CATALONIA (ES51)

Population	Stage of development (1=Lowest; 5=Highest)
7 499 000	4

2020 EU-Social Progress Index (SPI)

Score (0-100)	67.1
Rank	135/240
EU score (0-100)	66.7

Division of powers – Spain

Member state with legislative powers at the sub-national level – unitary state organised on a decentralised basis.

Regional level: Autonomous communities enjoy important autonomy and have legislative powers, with the right to self-govern.

OECD Regional Wellbeing (0-10)

Education	4.7
Jobs	5.2
Income	4.0
Safety	9.6
Health	9.7
Environment	5.5
Civic engagement	4.4
Access to services	7.6
Housing	5.6
Community	7.9
Life satisfaction	4.8

EU frameworks: European Green Deal (2019), preceded by Europe 2020 strategy (2010).

Regional CE strategy: Strategy to promote the green economy and the circular economy (2015).

Responsible institution: The Regional Government of Catalonia (Territorial and sustainability department).

Main objective(s): (1) To align, in competitiveness matters, to the standards of smart, sustainable, and inclusive growth of the EU and leading surrounding countries; (2) to provide coherence and visibility to the different plans towards green/CE of the different governmental departments; (3) to establish priorities for future governmental action; and (4) to

boost corporate leadership and the capacity to transition to circular/green economy, also for society as a whole.

Drivers: Interreg Europe CircE Project ('European Regions Toward Circular Economy') involves eight partners and representatives of different European social and economic scenarios. It seeks to enhance the ability of the involved regions' policy instruments to drive the transition towards more circular economies through the exchange of knowledge and experience, as well as broad stakeholder involvement. In the specific case of Catalonia, the 'Action plan to promote circular economy in the textile and beverage sectors 2019-2021' is in place as part of the project. 'Catalunya Circular' (Circular Catalonia) is an innovation hub and meeting point for companies and institutions that offer solutions for a more circular Catalonia.

Challenges: It envisages the key areas of action in terms of generating demand and creating market structures, improving access to funding, promoting R&D, and boosting internationalisation.

RIS3/S3: Research and Innovation Strategy for the Smart Specialisation of Catalonia RIS3CAT (2014-2020) (2014) – the exploration of the Catalan economy has resulted in pointing out three key vectors which will avail the region to successfully tackle the great social and economic challenges of the 21st century. One of the three vectors is the firm commitment to transforming the Catalan economy into a green economy, which is considered to offer promising niches for specialisation and generate opportunities to advance and enhance efficiency in all economic sectors.



FRIESLAND (NL12)

Population	Stage of development (1=Lowest; 5=Highest)
647 000	3

2020 EU-Social Progress Index (SPI)

Score (0-100)	78.2
Rank	26/240
EU score (0-100)	66.7

OECD Regional Wellbeing (0-10)

Education	6.6
Jobs	8.7
Income	3.8
Safety	9.9
Health	6.9
Environment	5.7
Civic engagement	8.4
Access to services	9.9
Housing	6.7
Community	8.3
Life satisfaction	9.3

Division of powers – The Netherlands

Member state without legislative powers at the sub-national level – unitary state organised on a decentralised basis.

Central level (state responsibilities): National issues; legislative and administrative power, but provinces and municipalities may issue provincial and municipal regulations, as long as they follow national law.

Regional level: The representative governing body at the provincial level is the **Provincial Council** (*Provinciale Staten*), while the executive body is the **Board (College) of the King's Commissioner** (*Commissaris van de Koning*) and the **Provincial Aldermen** (*Gedeputeerde Staten*).

National framework: *Grondstoffenakkoord* – national agreement outlining the country's commitment to a CE by 2050.

Regional CE strategy: *Circulair Fryslân: De Economie Van De Toekomst* (2015).

Responsible institutions: Province of Friesland, Municipality

of Leeuwarden, Circular Friesland Association, Metabolic, Urgenda.

Drivers: General joint activities outlined for each sector (setting up a platform, organising roundtable discussions); inspiring flagship projects and overarching activities; stimulating cooperation between different sectors, incubators, and accelerators; a platform to collect knowledge and attract companies that will supply the new circular products in the construction sector; the establishment of the Frisian Salt Institute to gather knowledge via projects in various test locations and related research; circular experts – catalysers and theme specialists; the promotion of industrial symbiosis; a focus on cultural diversity and extension of added value to CE; system thinking approach where the circular consumer is at the centre; changes in behaviour and mentality; circular business models and entrepreneurship; circular procurement; integral approach to education, including CE and sustainable development in education programmes, from primary-school to university level; circular construction; circular design.

Challenges: An initial need for opportunity analysis and correct stakeholder involvement.

RIS3/S3: RIS3 Northern Netherlands 2021-2027 (2021) - In the context of innovation, the Fryslân's activities are conducted in cooperation with the Provinces of Drenthe and Groningen in 'The Northern Netherlands Provinces'. Hence, the current Northern Netherlands's RIS3 is characteristic as it already relates sustainable development and smart specialisation. Compared to the traditional S3 which focus on priority areas, or sectors, the Northern Netherlands have expressed the objectives of the RIS3 in terms of societal challenges - for which the region has the capabilities to contribute to the solutions. The RIS3 for 2021-2027 is having direct links with the UN SDGs.



GALICIA (ES11)

Population	Stage of development (1=Lowest; 5=Highest)
2 705 000	3

2020 EU-Social Progress Index (SPI)

Score (0-100)	68.7
Rank	120/240
EU score (0-100)	66.7

OECD Regional Wellbeing (0-10)

Education	4.2
Jobs	3.5
Income	3.1
Safety	10.0
Health	9.0
Environment	8.0
Civic engagement	3.5
Access to services	6.8
Housing	7.2
Community	8.2
Life satisfaction	4.4

Division of powers – Spain

Member state with legislative powers at the sub-national level – unitary state organised on a decentralised basis.

Regional level: Autonomous communities enjoy substantial autonomy and have legislative powers, with the right to self-govern.

EU frameworks: Closing the loop – An EU action plan for the Circular Economy (2015).

National frameworks: Spanish Circular Economy Strategy: España 2030.

Regional CE strategy: Galician Circular Economy Strategy 2020-2030 (2019).

Responsible institution: The Regional Government of Galicia.

Main objective(s): (1) To promote a knowledge-based economy; (2) to drive a life cycle and eco-design philosophy in the corporate/market culture; (3) to promote a CE information platform; (4) to drive new business models based

on use/utility (rather than product ownership); (5) to employ CE as a demographic engine, highlighting the riches of local resources (human or natural); (6) to implement eco-efficient urbanism; (7) to implement eco-efficient water-cycle management; and (8) to prioritise circularity in waste management, including a hierarchy of waste-recovery strategies (favouring regeneration of primary materials).

Drivers: The main drivers are envisaged in terms of the general application of systematic eco-design practices, creation of new activities and business model innovation, clear promotion of R&D for the generation of scientific and technical knowledge, together with increased resource efficiency and extended management of materials along their life cycle, as well as increased education and information exposure for all relevant stakeholders. In this sense, Galicia has a clear advantage with respect to its already built (knowledge) capacity in the agricultural and fishing sectors. Economic advantages are viewed as facilitating the implementation of circular strategies.

Challenges: Stakeholder collaboration, led by the government, is necessary and challenging. Incorporation of systematic strategies (as drivers) and the alignment of the Spanish government with these are necessary. In particular, the Spanish government should build coherence between the actions of different regions in Spain to ensure their success (most importantly, in terms of the changes to market incentives and structure necessary for a real transition).

RIS3/S3: Smart Specialisation Strategy of Galicia (2014-2020) (2014) – one of the three challenges for the future of Galicia was “New model for management of natural and cultural resources based on innovation”. In order to tackle that, one of the related priorities was “Modernisation of traditional activities linked to local resources, characterised by an intensive use of endogenous resources for sustainable growth.



EXTREMADURA (ES43)

Population	Stage of development (1=Lowest; 5=Highest)
1 071 000	2

2020 EU-Social Progress Index (SPI)

Score (0-100)	64.3
Rank	151/240
EU score (0-100)	66.7

OECD Regional Wellbeing (0-10)

Education	1.7
Jobs	0.5
Income	2.4
Safety	9.8
Health	8.5
Environment	7.4
Civic engagement	5.5
Access to services	6.8
Housing	6.7
Community	9.3
Life satisfaction	5.9

Division of powers – Spain

Member state with legislative powers at the sub-national level – unitary state organised on a decentralised basis.

Regional level: Autonomous communities enjoy substantial autonomy and have legislative powers, with the right to self-govern.

EU frameworks: Europe 2020 strategy (2010); Closing the loop – An EU action plan for the Circular Economy (2015); Europe 2030 project (2010); Europe 2020 strategy; Horizon 2020 programme.

National frameworks: Spanish Circular Economy Strategy: España 2030; National Plan for Management of Residues (2016-2022); Spanish Bioeconomy Strategy Horizon 2030; Climate Change and Energy Transition Law.

Regional CE strategy: Extremadura 2030: Strategy for green and circular economy (2017).

Responsible institution: The Regional Government of Extremadura.

Policy instruments addressed: Social concentration commission; directive committee *Extremadura* 2030; regional strategy coordination commission; territorial commission; technical office *Extremadura* 2030; thematic commission; *Extremadura* 2030 Forum.

Main objective(s): (1) To build a sustainable development model based on green and circular economies; (2) to design a stakeholder involvement process in the governance model; (3) to enable a social transformation based on mass capacity building of citizens; (4) to make *Extremadura* into an internationally recognised laboratory for green and circular economy matters (in terms of R&I); and (5) to identify and valorise stakeholder interactions with respect to the green and circular economies.

Drivers: Stakeholder involvement and knowledge-sharing as a new form of governance are seen as the key enabler of the transition. Monitoring framework inspired by the UN's SDGs is proposed to aid the transition.

Challenges: Achieving compromise between decision-makers to enable the governance process; understanding the thematic and territorial context, the structures, and governance frameworks for a proper application of the governance model; ensuring a proper resource allocation to boost trust and stakeholder participation; as well as enabling proper comprehension of the multi-level governance model.

RIS3/S3: RIS3 Extremadura 2027 (2021) - The RIS3 Extremadura 2027 specialisation pattern identifies areas of opportunity that need to develop business capacities to take advantage of them, such as the Green Economy, the Circular Economy, the Silver Economy, and the Digital Transformation of all business sectors.



REGION OF CENTRAL MACEDONIA (EL52)

Population	Stage of development (1=Lowest; 5=Highest)
1 877 000	2

2020 EU-Social Progress Index (SPI)

Score (0-100)	55,8
Rank	211/240
EU score (0-100)	66.7

OECD Regional Wellbeing (0-10)

Education	6.6
Jobs	0.6
Income	2.3
Safety	10.0
Health	7.2
Environment	4.7
Civic engagement	5.1
Access to services	4.2
Housing	3.3
Community	4.1
Life satisfaction	0.4

Division of powers – Greece

Member state without legislative powers at the sub-national level – unitary state organised on a decentralised basis.

Central level (state responsibilities): general powers for designing and implementing national policies.

Regions are responsible for the administration of affairs of their district. They shape, plan, and implement regional-level policies, under the principles of sustainable development and the social cohesion of the country, taking into account both national and European policies.

National frameworks: Revised National Plan for Waste Management, National Strategy for Circular Economy.

Regional frameworks: Regional Waste Management Plan.

Regional CE strategy: Action Plan Towards Bio-Based Circular Economy (2019).

Responsible institution: Regional Development Fund of Central Macedonia – on behalf of the Region of Central Macedonia.

Policy instrument addressed: Regional Operational Programme of Central Macedonia 2014-2020.

Main objective: To strengthen cooperation in the energy utilisation of biowaste.

Drivers: 17 bio-gas plants active in the region – significant potential; knowledge transfer from the participation in the BIOREGIO (Interreg) project; advisory and support for innovation and knowledge transfer from research results to industrial partners; facilitation and creation of communication channels for information exchange and coordination among administration, scientific community, and economic and societal actors; innovation vouchers for SMEs for funding actions based on waste management and waste as an energy form.

Challenges: The need to utilise additional biowaste streams, the need to cooperate with research organisations for further R&D in the production of biomass energy, information exchange, the need to strengthen the value chain on biowaste and create contacts and synergies among bio-gas plant operators and producers of other forms of biowaste and bring together bio-gas plant operators to exchange information and pursue common goals for anaerobic digestion technologies.

RIS3/S3: Research and Innovation Strategy for Smart Specialisation (RIS3) 2014-2020 (2015) – There are four identified priority areas of the RIS3: Agri-food, Tourism Textile and Material (mainly Construction), which are being supported by the following areas, technologies, sciences: Information and Communication Technologies, Energy, Environment, and Logistics.

3.5.3 Discussion of results

From the **Regions' Blueprints** presented in the previous section, eight visions and action plans for regional efforts to transition towards a CE can be identified. The differences between these visions reflect the unique characteristics of the respective regions' cultures, histories, economic and industrial structures, political reality, and institutional arrangements. Some regions base their CE strategies on their predominant sectors and place-based capabilities (supporting **Finding III**). For instance, Central Macedonia is focusing on biowaste from its agricultural and food sector (Action Plan Towards Bio-Based Circular Economy, 2019); Luxembourg is aiming to be the first circular nation where new business models based on the product as a service principle become standard (Circular Economy Strategy Luxembourg, 2021); and the region of Friesland is anchoring its strategy on five emerging sectors that are crucial for the CE and for the region: namely, agriculture, plastic, construction, organic-waste streams, and saline agriculture (Circulair Fryslân: De Economie Van De Toekomst, 2015). The Central Denmark Region is intending to be a circular region by 2030 with sustainable procurement, reuse, recycling, renewable energy, and minimal consumption (Sustainability Strategy 2030 for Central Denmark Region, 2021). In the case of the Brussels Capital region – a large consumption node with limited production activities, capacities, and resources – the focus should be on sustainable consumption, as the urban policies have a partial impact on the production located outside its boundaries (Christis *et al.*, 2019). Accordingly, one of the main aims of the BRPCE is to relocate the economy to Brussels to produce locally whenever possible and create added value for Brussels inhabitants (Brussels Regional Program for a Circular Economy 2016-2020, 2016). In the three Spanish cases, the standalone CE strategies have a broader focus.

Taking into account the division of power within the country, some regions have legislative powers that provide more diverse and powerful instruments and mechanisms for implementing the transition towards the CE (supporting **Finding III** and **V**). The Spanish and Belgian regions, for example, have more complex institutional arrangements. In the case of Luxembourg, which is a unitary state with a smaller population, the country simultaneously represents all three NUTS levels, thus reducing the complexity of multi-level governance.

As far as the S3/RIS3 strategies were concerned, some of the region were explicitly mentioning the circular economy, like it was the case with Luxembourg where the four economic sectors in the RIS3 were operating under the CE umbrella (Research and Innovation Smart Specialisation Strategy, 2017), or in the case of Extremadura were RIS Extremadura 2027 (2021) specialisation identified areas of opportunity that need to develop business capacities to take advantage of them, such as the green and circular economy of all business sectors. Catalonia states its commitment to transform the Catalan economy into a green economy, which is considered to offer promising niches for specialisation and generate opportunities to advance and enhance efficiency in all economic sectors (Research and Innovation Strategy for the Smart Specialisation of Catalonia 2014-2020, 2014), while Galicia defines one of the regional priorities to modernise the traditional activities associated to local resources, characterised by an intensive use of endogenous resources for sustainable growth (Smart Specialisation Strategy of Galicia (2014-2020, 2014).The new RIS3 Northern Netherlands 2021-2027 (2021), which includes the Friesland province, is anticipated to have direct links with the UN SDGs, while already the current RIS3 is distinctive for connecting sustainable development and smart specialisation. These findings are somewhat related to the findings emerging from **section 3.2.2**, where the RIS3 is seen as fundamental delivery mechanism of the EU's new sustainability agenda. This is apparent from the clearer links between the S3/RIS3 and the notion of CE, green economy, and sustainability of the more recent S3 regional strategies for the latest programming period of 2021-2027 (supporting **Finding III** and **VI**).

The analysis of the regional strategic documents to extract the drivers and barriers was a challenging task, as these elements were not explicitly mentioned. However, the actions and initiatives presented in the strategies were established on the basis of the challenges the regions are facing, as well as the driving forces of the transitions. Therefore, the underlying drivers and barriers could be identified for each region, and these are presented in the respective Region's Blueprint.

In the new CE strategy, Luxembourg is distinguishing the CE as a driver of innovation, contributing to the further differentiation of the Luxembourg economy and to the creation of new value chains in the region. The insufficiency of the sole top-down approach of implementation by a single entity is highlighted, pointing to the need of numerous stakeholders and their contributions, with clear mandates and circular aims. Moreover, the

Circular Economy Strategy Luxembourg (2021) shall offer direction and function as an enabler and multiplier for both top-down and bottom-up initiatives at national and regional level. At the national level the related ministries and institutions were pointed as drivers, while on more practical grounds the relevant public projects founded on circular principles were identified as enablers for the transition. As for the governance of the strategy, the establishment of a permanent consultation and coordination process was amongst the key drivers of the CE in Luxembourg. Last but not least, a portal related to CE in Luxembourg was created, acting as a focal point for all the related CE developments and encourage involvement of new stakeholders (Circular Economy Strategy Luxembourg, 2021).

The 2016 BRPCE was developed as a broader and more holistic programme, as the region had gained valuable experience from its employment-environment alliance, which had mobilised diverse actors to develop environment-related industries. This corroborated, once again, the constructiveness of uniting the public, private, and non-profit sectors under the umbrella of a shared objective. As clearly stated in one of their reports, this balanced approach was a major success factor, with the top-down approach by the government decision-makers having a clear trajectory and the bottom-up initiatives coming from local and sectoral stakeholders who know what is needed and how to put this into practice on the ground. This multi-level, cross-sectoral collaboration was also identified as the largest challenge for the implementation of the strategy. The BRPCE programme is designed as a 'living strategy', being revised every 18 months as an incorporated mechanism to challenge results, revise measures, and involve more sectors and stakeholders (Brussels Regional Program for a Circular Economy 2016-2020, 2016).

In the Sustainability Strategy 2030 for Central Denmark Region (2021), the vision is to be a circular region with sustainable procurement, reuse, recycling, renewable energy, and minimal consumption in 2030, and in 2050 to be CO₂ neutral. CE is one of the 4 main areas of this wider strategy of the region with the following specific goals by 2030: 1) 30% reduction in use of resources in procurement and daily operations; 2) 30% reduction in waste and 3) 70% recycling of waste. The strategy though is quite vague in terms of presenting some of the drivers and challenges that the regions is facing in the transition towards the CE (Sustainability Strategy 2030 for Central Denmark Region, 2021).

The region of Catalonia was one of the first to design a CE strategy. This appeared in 2015 and the new strategy was published mid-2021. With its participation in an Interreg project, the region is aspiring to enhance the policy instruments at their disposal to foster the transition. Another interesting driver is the focus on the innovation hub, which brings together stakeholders to exchange knowledge and experiences and provide circular solutions (Strategy to promote the green economy and the circular economy, 2015).

A wide range of stakeholders in the region of Friesland have been well aware of the CE concept and its practical benefits since 2015, and they have been able to identify opportunities for broad cooperation to create new jobs and ensure environmentally sustainable economic growth. Initially, a regional metabolism analysis for Friesland was conducted by Metabolic, and the regional context was mapped, along with the commodity flows and needs of local stakeholders. The presentation of this report marked the birth of the Circular Friesland Association, founded by 25 companies and organisations in a major step towards a circular Friesland. The system thinking approach was adopted for the CE transition in the region, emphasising different segments of society whose needs must be considered throughout the transition – from circular procurement, circular design, integral education on CE, focus on the consumer and changes in behaviour and mentality, to specific measures in specific industrial sectors and circular experts acting as a driving force of the CE (Circulair Fryslân: De Economie Van De Toekomst, 2015).

The focus of the CE strategy in the region of Galicia is primarily R&D solutions for generating scientific and technical knowledge, building capacity, and increasing education and information exposure for all relevant stakeholders. The latter of these is also identified as one of the main challenges, requiring collaboration between different stakeholders and coherence between regional actions in different Spanish regions (Galician Circular Economy Strategy 2020-2030, 2019).

The region of Extremadura, except the main objectives of the CE strategy, provided main governance objectives by stakeholders. For the public sector, the following were identified: initial leadership co-leadership boosting, process development and coordination, resource provision, consensual decision guarantee, governance management, and evaluation coordination. For civil society and individual citizens, the contribution to needs and problems

identification contribution to solution development, knowledge from experience, closeness and proximity boosting, propositions for betterment, and participatory evaluation were cited. The governance objectives for academia were as follows: diagnosis of needs and problems, innovation in solutions, knowledge transfer, and participatory evaluation. Finally, for corporations, the following governance objectives were acknowledged: contribution to the identification of needs and problems, investment in productive activities, project development, experience sharing, propositions for improvement, and participatory evaluation. The primary driving forces of the CE transition were reported as stakeholder involvement and knowledge-sharing, along with the establishment of a monitoring framework to monitor the process. At the same time, the multi-level governance model and broad stakeholder participation were observed as the largest challenges (Extremadura 2030: Strategy for green and circular economy, 2017).

The Region of Central Macedonia developed its CE strategy as part of the BIOREGIO *Interreg* project, advocating for a shift from the focus on circular bioeconomy in the Regional Operational Programme of Central Macedonia 2014-2020. This was an attempt to encourage and streamline interventions that promote the transition to a business model built around CE principles. Except the integration of the CE activities in the 2014-2020 programming period, the integration in the programming period 2021-2027 will be reflected at the regions' financial priority axes. The final pillar of the strategy is the establishment of the targeted strategic actions of RIS3 in the Central Macedonia region to enforce the CE. The key policy changes in this respect concern the introduction of waste management as a priority, as well as the reuse of waste as an energy form. The need for cooperation with all relevant stakeholders – including research organisations for R&D purposes – was highlighted as a challenge, alongside issues regarding information and knowledge exchange, highlighting the need for a platform or hub to act as a meeting point for various stakeholders (Action Plan Towards Bio-Based Circular Economy, 2019).

The overall picture is rich and diverse, even with only eight regions included in the analysis; and this mirrors the multifaceted nature of the CE transition, which is influencing many aspects of our society.

3.5.4 Conclusions and recommendations

The **section 3.5** has given an account of the drivers and barriers to CE implementation encountered at the regional level, in eight European regions. This topic was also analysed as part of the literature review (**section 2.5.6**) and grey literature analysis (**section 3.4**) to identify the confronted and perceived drivers and barriers.

The findings suggest several courses of action for regions that are leading the transition towards a CE, as well as regions that have just begun their journeys. The first implication is that a **place-based approach** is needed, and regions should identify strategic sectors of existing or potential competitive advantage in which they can innovate, specialise, and create capabilities, thereby distinguishing themselves from other regions. Economic, social, environmental, political, and geographical factors should be considered, alongside the institutional settings and industrial profile of the region. Differences in territorial contexts create different sets of needs and opportunities, which the CE strategies must acknowledge (supporting **Finding III** and **V** from **section 2.6**).

A **balanced approach to implementation** is required. On one hand, top-down efforts are needed to set the general vision and direction, establish the framework conditions, and direct the flow of funds and regulatory mechanisms. On the other hand, bottom-up initiatives that emerge from society itself are equally essential, as these include grassroots movements, the engine of entrepreneurship, green entrepreneurship, and circular business models (supporting **Finding IV** from **section 2.6**).

These efforts in both directions must be coordinated, and the silo-mentality must be avoided. For that purpose, a **functional and effective multi-level governance mechanism** should be put in place, enabling effective channels of communication, implementation, and reporting – both vertically (e.g., from local governments, through regional, national, and international governments, and vice versa) and horizontally (e.g., regional governments within a country).

The creation of so-called '**circular hubs**' or **multi-stakeholder platforms** for communication and knowledge transfer would contribute to the acceleration of the transition, bringing together actors from the government, industry, academia, and society. These initiatives can be established nationally or internationally, and they can have different forms (virtual versus

physical), with different responsibilities and power given by the state according to the needs of the project (supporting **Finding IV** from **section 2.6**).

Participation in **cross-disciplinary international projects** (such as the *Interreg* projects) also contributes to sharing of best practices, solutions, and policy learning, with the ultimate goal of helping regional and local governments to develop and deliver better policy.

The creation of the regional CE strategies as 'living strategies', with a reasonable **revision mechanism** to account for the latest developments and adjust the policy and its instruments of implementation accordingly is also recommended. This, in turn, will require a **monitoring mechanism** in place to track the progress towards a more circular economy, having an integrated and sustainable impact on people and places (supporting **Finding VII** from **section 2.6**).

Finally, **Findings III** and **VI** from **section 2.6** are corroborated, where the RIS3 is seen as fundamental delivery mechanism of the EU's new sustainability agenda. This is apparent from the clearer links between the S3/RIS3 and the notion of CE, green economy, and sustainability of the more recent S3 regional strategies for the latest programming period of 2021-2027.

3.6 Synthesis of the findings

The review of the grey literature has revealed a number of research findings mainly corroborating the findings from the literature in **section 2.6**, as explained below.

I. General findings related to the field of regional CE

Considering that the main points of this finding were a result of the bibliometric and descriptive analysis on the academic literature, **chapter 3** did not provide supporting conclusions, except the point regarding the **close links between IS and CE**. This was encountered twice in the chapter, IS being a driver for regional CE implementation in the Friesland regional CE strategy in **section 3.5.2** and in **section 3.2** where the EU Council encouraged the EC and EU MS to mobilise and support regions and cities to stimulate IS between companies to minimise resource use among other initiatives for circular change.

II. Findings related to the implementation level

The pioneering role of cities and regions in the transition and their function as hubs for circular change was validated in **section 3.2** and **3.2.3**. Additionally, as stated in **section 3.5.1** and **Box 4**, the NUTS 2 regions were taken as the optimal level for CE implementation.

III. Policy-related findings

Section 3.2, 3.2.1, 3.2.2 and **3.2.3** validated the following policy-related findings - the regional authorities, alongside local and national ones, were described as enablers of the transition in the CEAP. But more importantly, the S3 is a key element for delivering the EU's sustainability agenda successfully, contributing to the capitalisation from the diverse EU innovation ecosystem. As discussed in more details in **section 3.5.3** based on the information in **section 3.5.2**, the regions have anchored their CE strategies on their **predominant sectors and place-based capabilities** – another point which has been corroborated from the literature review. This implies that a **place-based approach** is adopted, and regions should identify strategic sectors of existing or potential competitive advantage in which they can innovate, specialise, and create capabilities, thereby distinguishing themselves from other regions (**section 3.5.4**).

IV. Findings related to the approach of implementation

The **balanced approach for implementing CE** was preferred (**section 3.5.3** and **3.5.4**), particularly highlighted in the case of Luxembourg, though this was found to be both a major driver and barrier in the case of Brussels Capital Region (**section 3.5.2**). The strong stakeholder's engagement and a systemic approach for the transition was characterised as vital to foster partnerships across sectors and value chains as highlighted in the CEAP (**section 3.2.1**). In that context the establishment of the ECESP was considered crucial for bridging initiatives at different levels and being a knowledge hub and a virtual place for exchange of experience (**section 3.2.1** and **3.2.3**). The creation of so-called '**circular hubs**' or **multi-stakeholder platforms** for communication and knowledge transfer was overall considered as very beneficial as revealed in **section 3.5.2, 3.5.3** and **3.5.4** (e.g., region of Catalonia, Friesland, Extremadura, Luxembourg, and Central Macedonia). Participation in **cross-disciplinary international projects** (such as the *Interreg* projects) also contributes to sharing of best practices, solutions, and policy learning, with the ultimate goal of helping regional and local governments to develop and deliver better policy (**section 3.5.4**).

V. Findings related to drivers and barriers for implementation

The diversity of situations varying from region to region, including the outermost regions, as well as the economic and social effects of the transition were highlighted as factors to be considered in order to have a fair and inclusive transition for all (**section 3.2** and **3.2.3**). This was also validated in **section 3.5.3** and **3.5.4** where it was acknowledged that **economic, social, environmental, political, and geographical factors** should be considered, alongside **the institutional settings** and **industrial profile** of the region. As a result, differences in territorial contexts create different sets of needs and opportunities, which the CE strategies must acknowledge. The **institutional arrangements and the complexity of multi-level governance** stemming from the **division of power** within the country (**section 3.5.2**) were encountered on both sides as drivers and challenges (**section 3.4**), in line with the findings from **section 2.6**.

VI. Findings related to mechanism/instruments for implementation

The **different instruments** on disposal on cities and regions were encouraged to be used to support the transition, i.e., policies, investment and pilot projects, innovation platforms to stimulate the private sector and encourage IS activities (**section 3.2** and **3.2.3**). The **S3 was perceived as a fundamental delivery mechanism on the EU sustainability agenda**, and its place-based dynamics and directionality need can be of benefit to achieve a fundamental shift in policy and investment priorities (**section 3.2.3**, **3.5.3** and **3.5.4**). The analysis of the individual regional strategies revealed an inclination of **policy instruments** being in the focus of the regional strategies, like in the case of the region of Catalonia, Extremadura, Central Macedonia (**section 3.5.2**). What the grey literature analysis highlighted is the need for **functional and effective multi-level governance mechanism** which should be put in place, enabling effective channels of communication, implementation, and reporting – both vertically (e.g., from local governments, through regional, national, and international governments, and vice versa) and horizontally (e.g., regional governments within a country) (**section 3.5.4**). Moreover, taking into account the **division of power within the country**, some regions have legislative powers that provide more diverse and powerful instruments and mechanisms for implementing the transition towards the CE. For example, Spanish and Belgian regions having more complex institutional arrangements, while in the case of Luxembourg, which is a unitary state with a smaller population, the country simultaneously

represents all three NUTS levels, thus reducing the complexity of multi-level governance (section 3.5.2 and 3.5.3). The participation in **cross-disciplinary international projects** (such as the *Interreg* projects in the case of Catalonia and region of Central Macedonia) was highlighted as a vital instrument which contributed to promotion of the CE in the region (section 3.5.2, 3.5.3 and 3.5.4).

VII. Findings related to monitoring and measurement systems

The **lack of available regional monitoring framework and measurement system** was also noted in the grey literature, which was apparent from the very beginning since very limited information was found (section 3.3), likewise the **matter of regional data availability** (section 3.3.6). Ancillary CE measurement systems were considered relevant and proposed to be used as potential starting point and source of data for regional CE measurement. Namely, the numerous EU Scorecards and well as the Eco-Innovation Index (on EU MS level) (aligned with section 2.5.8), but more importantly the Regional Competitiveness Index (RCI) reporting numerous dimensions on NUTS 2 level were suggested. More importantly, the information provided in the **European Social Progress Index 2020 (2020 EU-SPI) Scorecards** and **OECD Regional Wellbeing** measure, both at NUTS 2 levels, was considered as very relevant addition, as explained in section 3.5.2. The **underrepresentation of the social dimension** was observed and hence some socio-institutional indicators were proposed (section 3.3.5). Last but not least, the **different approaches that regions adopted to measure and assess the CE adoption in their territories** was also observed like in section 2.6, and the case of BRPCE being designed as a living strategy was also found in section 3.5.2 and discussed in section 3.5.3 and 3.5.4.

Chapter four: Research Methodology

4.1 Introduction

In order to attain the objectives, set in **section 1.1** a detailed methodology needs to be devised. This chapter, hence, is detailing the research methodology and approaches selected for this research, as well as the procedures involved in conducting the data collection and data analysis. According to Trochim and Donnelly (2001) every research is influenced by a set of assumptions related to the way the universe is perceived and comprehended. These assumptions, in turn are determined by different factors, among which is the focus area of research (Trauth, 2001), the theme of inquiry (Myers, 2013) and to an extent the researchers own perspectives (Fielden, 2003). With the purpose to address the research questions, elaborated in the following section, this research is performed using entrenched frameworks via the lens of research philosophies (Kumar, 2014). Therefore, the “Research Onion” is presented in **Figure 34**, and the explanation of the underpinning research philosophies and strategies informing the current work is provided in the following sections. But before that, the key research questions are highlighted, which this research aims to provide answers to, as indicated in the sections that follows.

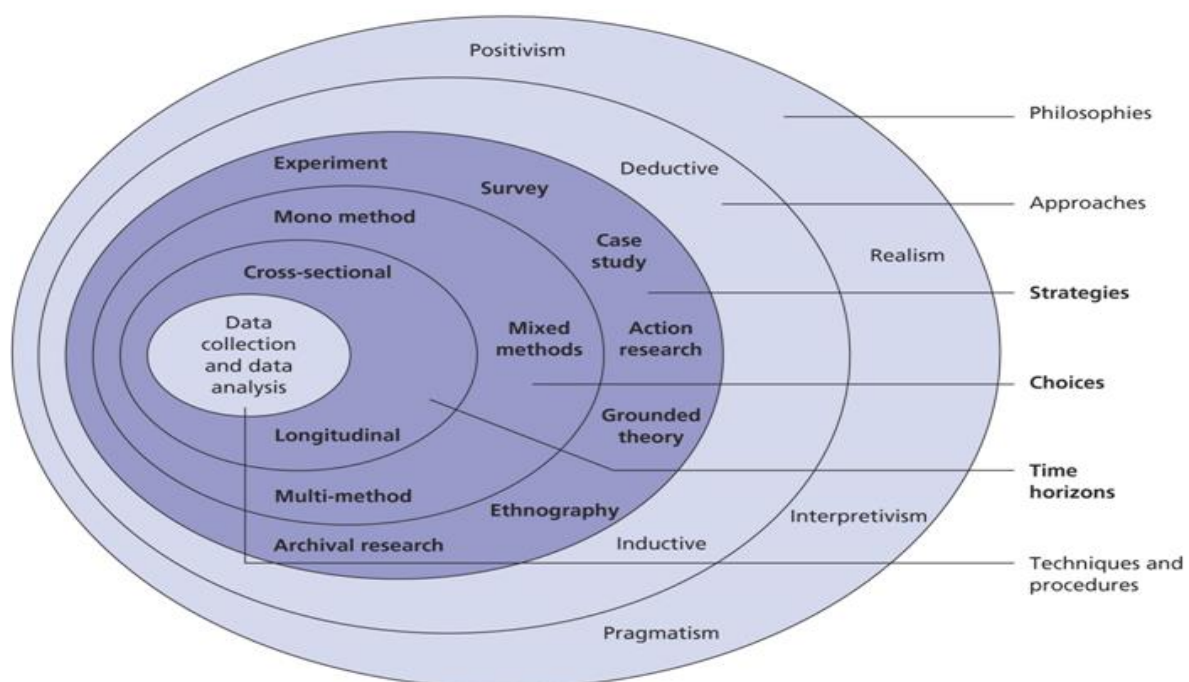


Figure 34: Research Onion (adapted from: Saunders et al., 2003)

4.2 Research Aim and Research Questions

The articulation of the research questions is one of the critical steps in any research process, as it identifies the problem to be investigated and directs the methodology choices. Moreover, a good research question contributes to develop a focused and arguable thesis and formation of a logical argument (Ratan et al., 2019). Based on the literature review (**chapter 2**) and grey literature review (**chapter 3**), more specifically the findings that were uncovered in **section 2.6** and further validated in **section 3.6**, the main research aim and respective questions which are the focal points of this research were formulated.

***Research aim:** To investigate whether Smart Specialisation Strategies (S3) influence the adoption of circular economy policies at the regional level.*

- **RQ1:** How does Smart Specialisation Strategies (S3), as (normative) institutional pressures, influence the adoption of circular economy policies at the regional level? In that context, does S3 impel the adoption of circular economy policies at the regional level, or in contrary it constitutes a form of lock-in which could even impede a region to adopt circular economy policies?
- **RQ2:** What is the corresponding impact on regional performance across a number of economic, social, and environmental metrics, of selected EU regions?
- **RQ3:** What other institutional pressures, normative, coercive, and mimetic, are influencing the adoption of circular economy policies at the regional level?

The visual representation between the research questions and the research findings are illustrated in **Figure 35**. As it can be observed, the main research findings which will directly be addressed with the further research are: **III. Policy-related findings** (RQ1 and RQ3), **VI. Findings related to mechanisms for implementation** (RQ1, RQ2 and RQ3) and **VII. Findings related to monitoring and measurement systems** (RQ3). Nevertheless, the remaining findings will be also tackled in an indirect manner, considering that ultimately the knowledge emerging from this research will somewhat address them.

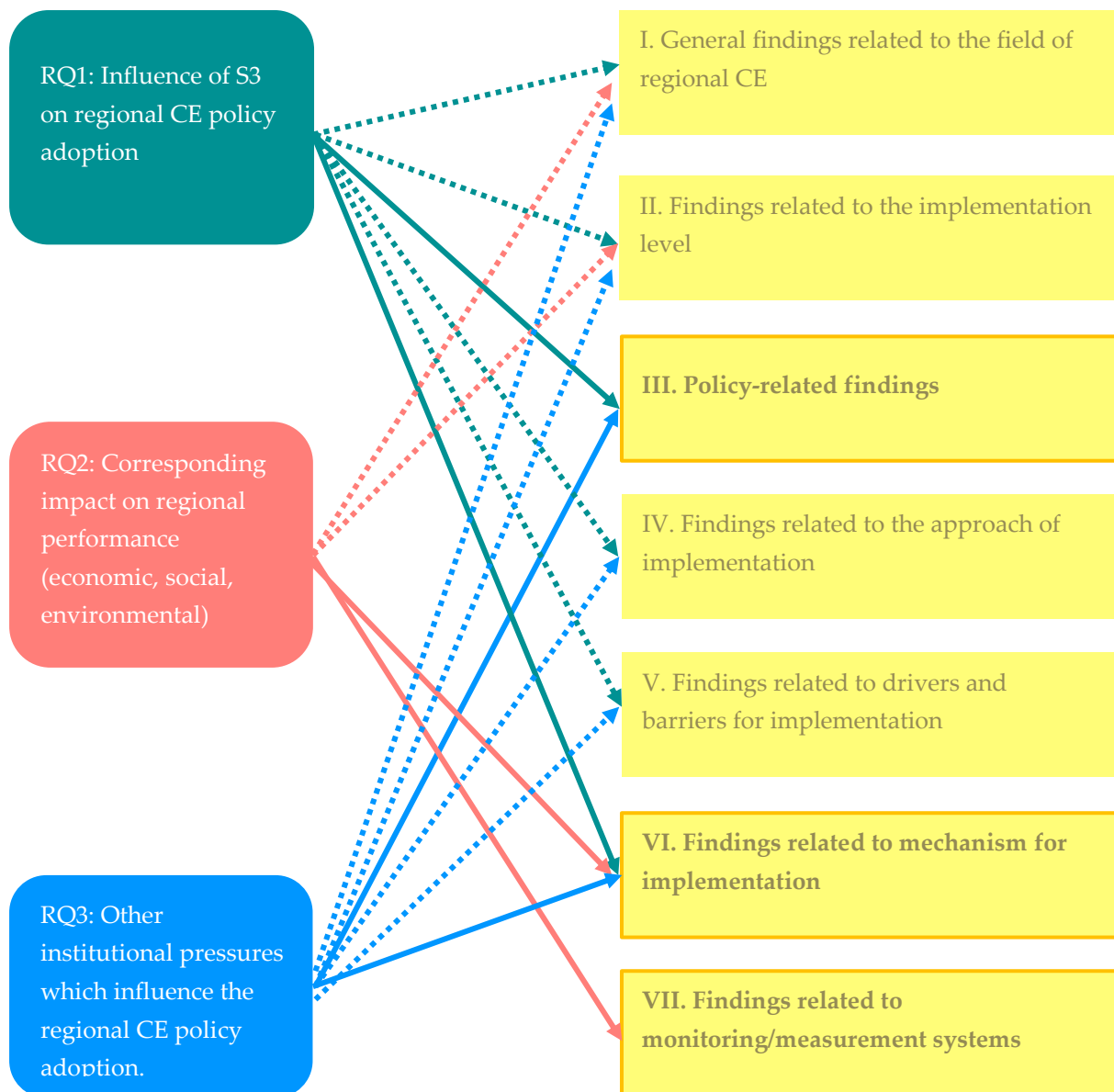


Figure 35: Visual representation of the relation between RQs and research findings (**section 2.6 and 3.6**), full line representing direct relation, and dotted line representing indirect relation

To provide viable answers to the research questions listed above, hence achieving the main research aim, a number of EU regions were selected as the sample to be analysed (based on whether CE was listed as a priority in their S3 and whether they have devised CE policy), which is discussed in the next **section 4.3**.

4.3 Rationale for sampling EU regions

Having into consideration the main research aim and research questions, stated in **section 4.2**, this study is trying to investigate whether S3 can drive the adoption of CE at the regional level, or on the contrary it can constitute a form of a lock-in which could even prevent a region to adopt CE policies. To present the regional positioning of EU NUTS 2 regions in respect of their adoption of CE policy and S3 relation, a matrix was developed (**Figure 36**). Two variables were taken into account, namely, whether the region had stated CE as S3 priority (x) and whether the same region had developed a regional CE policy in a form of standalone strategy, action plan or as integral part of a larger sustainability policy (y). The development of different matrices for various purposes has been noted so far in the literature, like Alonso-Almeida and Rodríguez-Antón (2020), Aranda-Usón et al. (2020), Poponi et al. (2020), Silvestri et al. (2020). Four groups of regions were identified, shown in four quadrants.

In **quadrant I**, the regions which had listed CE as one of their S3 priorities and had regional CE policy were positioned (green regions). In **quadrant II**, the regions which had CE as a S3 priority but didn't have a regions CE policy at the date when the data was extracted were presented (red regions). **Quadrant III** was representing regions which didn't have CE as S3 priority but had an existing regional CE policy (yellow regions), and finally **quadrant IV** was indicating regions which didn't have CE as S3 priority but also didn't have any existing regional CE policy so far (blue regions). The detailed stepwise process of developing the matrix, selecting the regions and the corresponding experts which will be contacted for primary data collection, as well as the databases used are explained below and presented in **Figure 37**. What is worth nothing at this stage is that the researcher didn't check whether the regions belonging to Quadrant III and IV have developed S3 generally, but this will be clearly elaborated below.

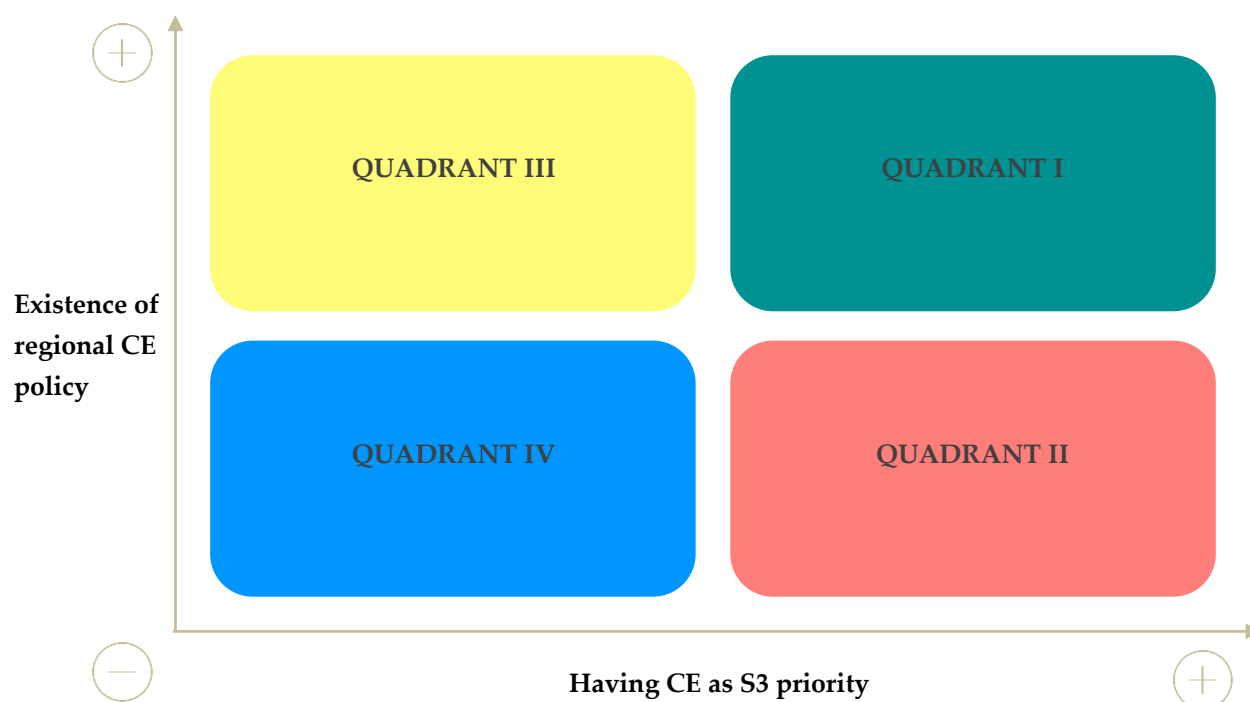


Figure 36: Matrix for categorising the regions for this research

As illustrated in **Figure 37**, the methodology for regional sampling, which served as the basis for selection of experts, comprised of three steps. All the data was extracted on 2nd February 2022. In **step 1**, the Eye@RIS3 platform, which contains the S3 priorities as indicated by MS and regional administrations, was used as the main database for gathering data. It is an open tool where regional and national authorities are regularly updating their S3 (also known as RIS3) priorities accordingly with their relevant stakeholders' constant participation (Entrepreneurial Discovery Process). The S3 priorities are defined through three categories, economic domains, scientific domains and EU Policy Objectives, and the search was done in all categories. Three separate searches were performed in the database, using the keywords "circular economy", "bioeconomy" and "green economy". The results were crosschecked for duplicates and removed accordingly, and the remaining regions were screened, and only the NUTS 2 regions proceeded in the next stage. In total 20 NUTS 2 regions have listed CE (10 regions), bioeconomy (5 regions) or green economy (5 regions) as their S3 priority. At this stage, the selection of experts for the primary data collection has happened, since the contact details of the experts related to the S3 documents was readily available at the Eye@RIS3 platform already. In most of the cases it was representatives of regional authorities, councils, and regional development agencies.

In **step 2**, Google was used as a primary database for performing the analysis and extracting the necessary information. Namely, a search was performed for all 20 regions whether they have an existent regional CE policy in place or not. In total 9 regions that had regional CE policies were positioned in the **quadrant 1** (green regions) and the respective policy was downloaded. Additionally, an effort was made to identify the regional authorities which devised the CE strategy and identify regional experts that can be contacted for the primary data collection afterwards. This means that for these 9 green regions, two sets of experts representing were collected, experts representing the S3 and experts representing the regional CE policy. The regions that didn't have existing CE policy, 11 in total, were positioned in **quadrant II** (red regions). It is worth mentioning the researcher's reliability on the availability of online information as well as the language barrier, hence possible omissions must be considered. The 20 NUTS 2 regions and their respective information are listed in **Table 26**.

In **step 3**, the Benchmarking Regional Structure database was used, combined with Google, with the purpose to find reference regions with structural similarities. This database allows to identify regions across EU which share similar structural conditions which are vital for innovation-driven development (social, economic, technological, institutional, and geographical features). These characteristics cannot be easily altered in the short run and in addition they proved to influence the way innovation and economic development happens within a region (Benchmarking Regional Structure). Therefore, for each of the 20 NUTS 2 regions identified in **step 1**, a reference region with structural similarities was identified in **step 3** using the Benchmarking Regional Structure database, meaning another 20 NUTS 2 regions were selected. In order to ensure geographical representation but also due to availability of online information and language barriers, for some regions were not selected reference regions, and for other were selected more reference regions.

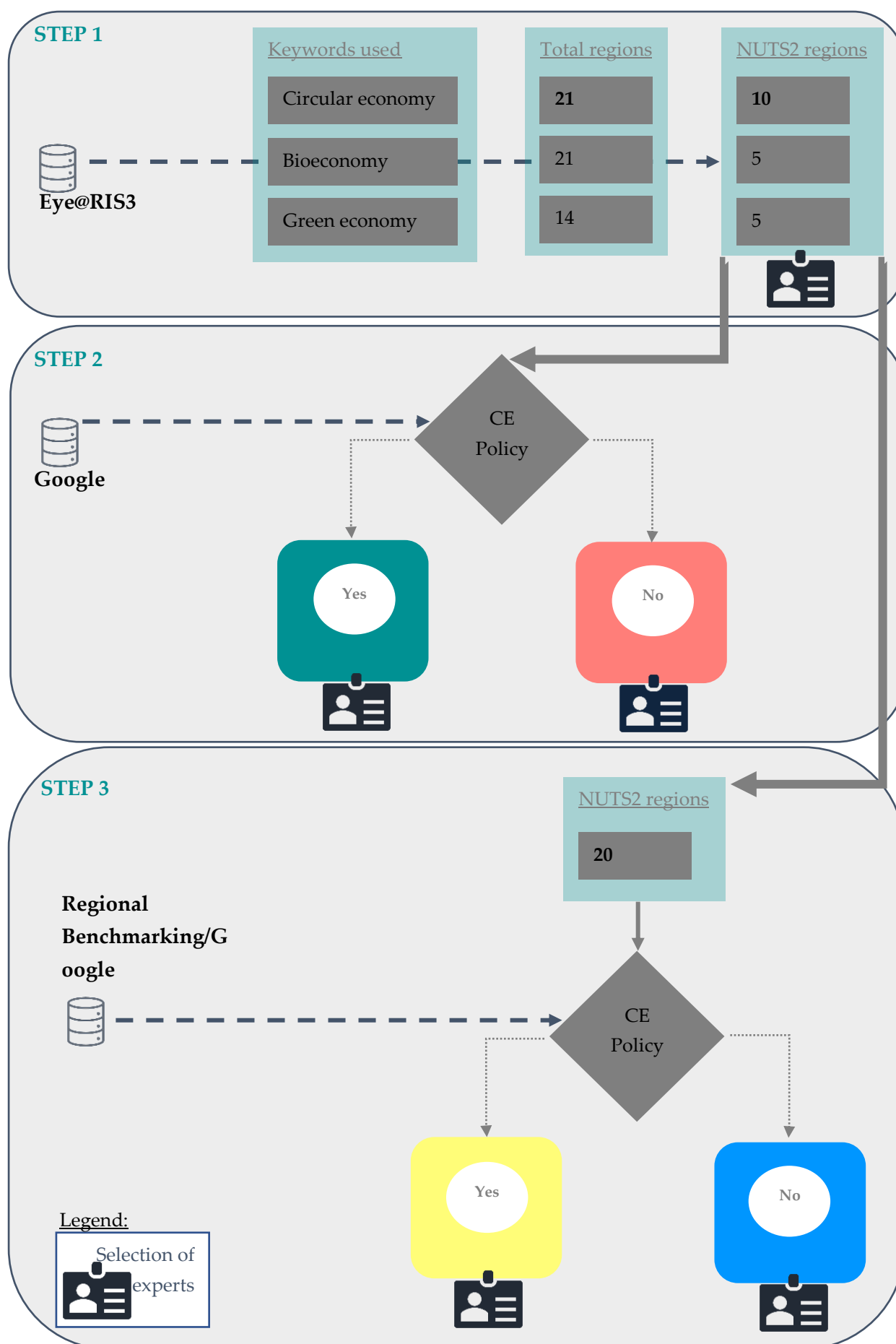


Figure 37: Methodology for regional sampling process

	NUTS ID	Country	Region/Country Name	CE policy	Quadrant
Circular economy	BE1*	Belgium	Brussels-Capital Region	Yes	I
	DK01	Denmark	Capital (region)	Yes	I
	DK02	Denmark	Zealand	Yes	I
	DK03	Denmark	South Denmark	No	II
	DK04	Denmark	Central Jutland	Yes	I
	ES21	Spain	Basque Country	Yes	I
	FR30 (or FRE1)	France	Nord-Pas-de-Calais	No	II
	LU**	Luxembourg	Luxembourg	Yes	I
	RO21	Romania	Nord-East	Yes	I
	RO31	Romania	South-Muntenia	Yes	I
Bioeconomy	DE94	Germany	Weser-Ems	No	II
	EL23 - EL63	Greece	Western Greece	No	II
	ES42	Spain	Castile-La Mancha	Yes	I
	PL31 - PL81	Poland	Lubelskie	No	II
	PL43	Poland	Lubuskie	No	II
Green economy	FR22 - FRE2	France	Picardie	No	II
	FR42 - FRF1	France	Alsace	No	II
	ITF5	Italy	Basilicata	No	II
	PL22	Poland	Slaskie	No	II
	PT30	Portugal	Madeira	No	II

Table 26: Sampling of regions positioned in quadrant I and quadrant II (Note: *NUTS 1/2, **NUTS 1/2/3 and country)

For each of the newly selected 20 regions, the same criteria were applied using the Google search - whether they have an existing regional CE policy. In total 13 regions which had regional CE policy were identified and positioned in **quadrant III** (yellow regions). Experts, representing regional authorities, which were involved in devising the CE policies were identified for primary data collection at this stage. The remaining 7 regions didn't have any CE policy in place, hence representing **quadrant IV** (blue regions). For the purpose of data collection, an effort was made to identify the regional authorities in these 7 regions and identify experts with their contact details. The second set of 20 NUTS 2 regions is listed in **Table 27**. As already mentioned above, in **step 3**, an effort was made to find reference regions, and consequently to detect the regions that have regional CE policy and the regions that don't have any policy in place, hence, the researcher didn't go in details to check whether these new 20 regions have S3 documents in general or not.

NUTS ID	Country	Region/Country Name	CE policy	Quadrant
ES51	Spain	Catalonia	Yes	III
AT13	Austria	Wien*	Yes	III
SE11	Sweden	Stockholm	No	IV
CY00	Cyprus	Cyprus/Kypros	Yes	III
BE3	Belgium	Walloon Region/Wallonia	Yes	III
ITH5	Italy	Emilia-Romagna*	Yes	III
BE3	Belgium	Flemish Region/Flanders	Yes	III
SK01	Slovakia	Bratislavsky kraj	No	IV
HU32	Hungary	Eszak Alföld	No	IV
CZ01	Czech Republic	Praha/Prague	Yes	III
EL52	Greece	Central Macedonia	Yes	III
ES11	Spain	Galicia	Yes	III
ES43	Spain	Extremadura	Yes	III
PT16	Portugal	Centro	Yes	III
NL12	The Netherlands	Friesland	Yes	III
LT00	Lithuania	Lietuva	No	IV
LV00	Latvia	Latvija**	No	IV
ES24	Spain	Aragon	Yes	III
ITF1	Italy	Abruzzo	No	IV
PL21	Poland	Malopolskie	No	IV

Table 27: Sampling of regions positioned in quadrant III and quadrant IV (Note: *Not a standalone CE Strategy, **Currently developing a CE Strategy)

The regional sampling represented in total 40 EU NUTS 2 regions and 20 countries. In terms of the experts identified for the policy Delphi study, 98 were collected initially, based on the developed matrix representing the four quadrants. However, considering the low response rate, additional 71 experts were contacted from other EU regions, the vast majority of them coming from regional authorities, councils, regional development agencies or higher hybrid organisations and institutions which activities were closely related to the regional implementation of the CE. In total 169 experts were contacted via email and LinkedIn messages. The final list of policy experts which participated in the primary data collection is available in **Appendix C**, and the detailed process is elaborated in **section 4.7.2** and **4.7.3**. It is worth noting that from the 32 regions which participated in the online survey (see **section 5.2, Table 32**), 21 regions were the ones identified from the regional sampling and only 11 regions were newly identified. Out of those 21 regions, 6 were from quadrant I, 3 regions from quadrant II (see **Table 26** for regions in red boxes), while 9 regions were from quadrant III and 3 regions from quadrant IV (see **Table 27** for regions in red boxes).

4.4 Theoretical lenses and framework

Grant and Osanloo (2014) stress the importance of researchers considering their theoretical framework, citing this as one of the most important aspects of the research process. They call this the 'blueprint' of the whole dissertation inquiry and the foundation on which the knowledge is built (Adom et al, 2018; Grant and Osanloo, 2014). The theoretical framework comprises the theory that underpins the researcher's rationale, their understanding, and their plans for researching the topic, including the concepts and definitions from the theory that are pertinent to the research (Grant and Osanloo, 2014). The theoretical framework provides a worldview or lens that employs knowledge from existing research to make sense of the data in the new study (Adom et al, 2018; Kivunja, 2018; Grant and Osanloo, 2014).

In this section, institutional theory (IT), the theoretical lens applied in this study, is briefly explored, along with an explanation of how this theory will inform the research. According to Scott (1987), IT explores the established and resilient social structures that provide societal stability. In his framework of IT, Scott (2008) proposes that the institutions be distinguished into three pillars: *regulative*, *normative*, and *cultural-cognitive*. While distinct, these are complementary, and each is instrumental in ensuring the resilience of the social structure.

IT indicates that the regulative, normative, and cultural-cognitive pillars conduct *coercive*, *normative*, and *mimetic institutional pressures or mechanisms*, respectively, to impact organisational social behaviour (**Table 28**) (DiMaggio and Powel, 1983). *Coercive* pressures arise from power relationships, such as rules, laws, and sanctions. *Normative* pressures are related to what is believed to be 'the right thing', and they are closely linked to certifications and accreditations. *Mimetic* pressures emerge mostly from uncertainty, where organisations imitate their successful or dominant peers thought to be more authoritative in the field (Widmer and Prior, 2019; Scott, 2003; DiMaggio and Powel, 1983). Widmer and Prior (2019) claim that each of these three sources of institutional pressures could individually be a base of legitimacy, providing social acceptability and credibility. Legitimacy, in broad terms, is defined as the premise that the actions of the organisation are in line with the socially composed system of norms, values, and beliefs. For example, as indicated in **Table 28**, under coercive pressure of the threat of legal sanction, organisations obey relevant protocols and rules. Furthermore, they adhere to morally governed normative pressures to ensure they are

certified, accredited, and not shamed. Finally, organisations adjust to mimetic pressures to win cultural support.

	Regulative	Normative	Cultural-cognitive
Pressure mechanisms	Coercive pressures to follow regulative rules in order to avoid negative sanctions	Normative pressures as a social obligation and binding expectations to social norms and rules	Mimetic pressures suggest that taken-for-granted common share believes exist
Indicators	Rules Laws Sanctions	Certifications Accreditations	Common beliefs Shared logics of action Isomorphism
Basis of legitimacy	Legally sanctioned	Morally governed	Comprehensible Recognisable Culturally supported

Table 28: Institutional pressures/pillars (**Source:** Widmer and Prior, 2019; Ranta et al., 2018; Scott, 2008)

4.4.1 Institutions and regional development policies

In more general development context, Rodríguez-Pose (2013) states that institutions are fundamental for economic development, and they need to be considered in any development policy. Furthermore, he argues that a regional development strategy which showed results in one region might not certainly deliver the same outcomes in another. He is drawing a parallel between regional economic development and bicycle (**Figure 38**), where “a well-designed and functioning development strategy would need two well-rounded wheels: a back institutional wheel with efficient formal and informal institutions propelling the bicycle forward and a front development strategy wheel tailor-made to match the institutional environment in which the development intervention takes place” (p. 1042).

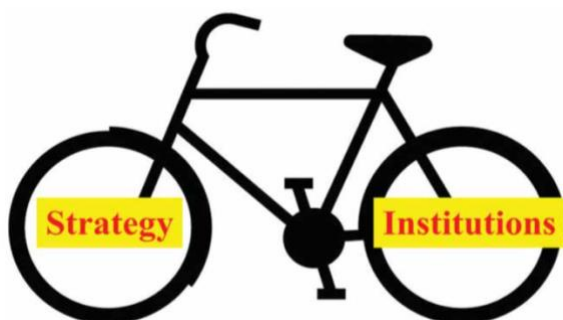


Figure 38: The “regional development bicycle” (**Source:** Rodríguez-Pose, 2013)

However, more often a region will fall into one of the three cases shown in **Figure 39**. In the first case (a) the over ambitious top-down regional development strategy will be followed by an insufficient or inadequately developed local institutions., implying the implementation of the strategy will not be possible. In the second case (b), the developed strategies are poorly devised, and the institutional arrangements are also weak, suggesting that any progress will demand huge effort. In the last case (c), there is not really a strategy being developed and the local institutions are also very poor, so it is virtually impossible to go forward in terms of economic development (Rodríguez-Pose, 2013). Hence, the institutional settings of a region are of vital importance for the formulation of any type of regional development policy, including the regional CE policy, and the link between the two which proved to be a determining factor when it comes to actual implementation of the policy.

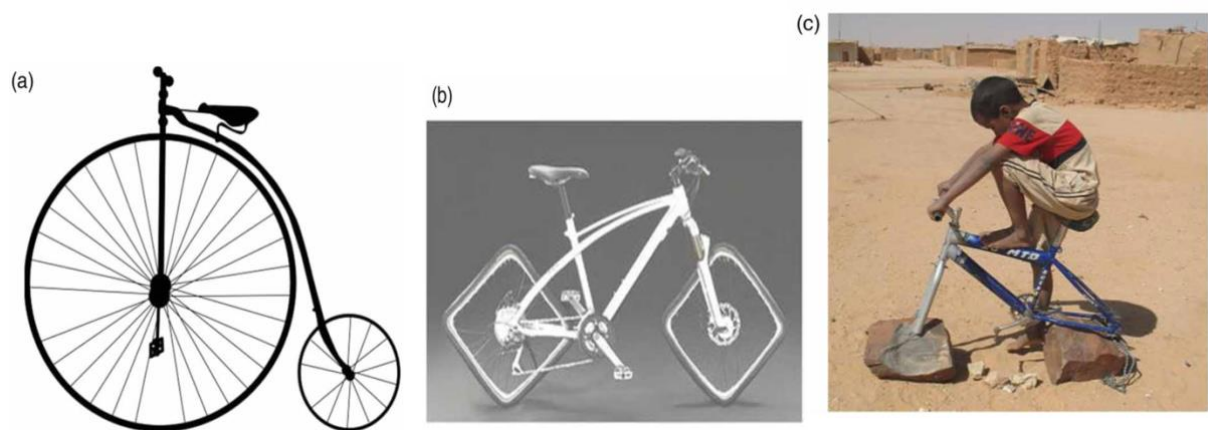


Figure 39: The mismatch between development strategies and institutions: (a) ‘Penny farthing’ equilibrium; (b) ‘square wheels’ situation; and (c) ‘bicycle frame’ situation (**Source:** Rodríguez-Pose, 2013)

4.4.2 Institutional theory in the circular economy area

According to Allen et al. (2021) and Hofstetter et al. (2021) the CE research is instigating to gain an IT perspective only recently, and the scarcity of literature investigating the link between IT and CE is partially due to atheoretical nature of research of CE. However, an increased interest in the link between IT and CE is anticipated (Allen et al. 2021), and Widmer and Prior (2019) and Liu et al. (2018), argue that IT can be used to explore the adoption of CE practices at different levels. Alonso-Almeida and Rodríguez-Antón (2020) claim that so far IT has been applied to organisations in the effort to align their practices to the environmental pressures, rather than territories and regions. The comparative case study

of Kaplan (2022) analysed EU's and China's institutional change efforts towards the CE from an institutionalist viewpoint. The findings showed that the institutional rationality of both EU and China had a vital role in their resolutions to commence a CE oriented institutional change process and formed their approaches to attain their institutional change objectives.

Several studies either referred to the importance of institution and institutional environment in the transition towards the CE or applied the IT as their theoretical framework for conducting their research. The paper of Ingstrup et al. (2021) clarifies the institutional logics of academia and practitioners within industry and government, along with the alignment and misalignment arising when these stakeholders cooperate. Based on the theories of alignment and misalignment and institutional logics, an explorative study of a CE cluster from the Tampere region (Finland) is performed. Agovino et al. (2020) presented the importance of institutional quality factors (voice and accountability, government effectiveness, regulatory quality, rule of law and control and corruption) for the adoption of effective separate collection of recyclable waste materials in 103 Italian provinces (NUTS 3 regions), between the years 2004-2011.

Henrysson and Nuur (2021) reflected on the importance of institutions in the establishment of new development routes in regional industrial development in the CE arena. In order to comprehend the driving forces and obstacles for shifting the sociotechnical systems in natural resource-dependent regions towards being more circular, an inquiry of several factors was made, including facilitating and restricting role of institutions, the local circumstances of transformation, institutional interplay, and patterns of lock-ins. The results from the study of Sastre et al. (2018) pointed to a weak enforcement mechanism cascading downwards from the national strategies to the practical regional application of the foreseen measures in the Spanish regions. Additionally, they called for a harmonised regulatory framework on CE-related matters which will ensure homogeneous approach across all regions in the country. Hence, it is vital to further explore the types of mechanisms available to different regions and determining the correct combination of mechanism that should be introduced in different regions.

The study of Alonso-Almeida and Rodríguez-Antón (2020) applied the institutional theory to examine the role of institutional pressures (coercive, normative, and mimetic) on the diffusion

and application of CE from the state to the regions. The findings showed coercive and then mimetic pressures were the most influential one for the development of CE initiatives in Spanish regions, while normative pressures were not so pertinent. This study and its results are crucial for providing guidance on how to advance the CE transition by applying different types of institutional pressures. Additionally, this seminal work and findings will shape the theoretical framework of the thesis.

When it comes to the typology of institutional pressures in the context of adoption CE at the regional level, a collection of studies and their contributions is presented in **Table 29**. This compilation of literature was the basis for proposing the main groups of institutional pressures within coercive, normative, and mimetic pressures which could potentially influence the adoption of CE policies in European regions, shown in **Table 30**. Moreover, they were the basis for developing the Survey, being part of the empirical study as the first stage of the policy Delphi study.

Study	Contribution
Allen et al. (2021) <i>IP general context</i>	Three types of institutional pressures: <ul style="list-style-type: none"> - Coercive emerging from the power of centralised government, large corporations, and foundations - Normative raising from social expectations - Mimetic coming from the need to copy or mime other's strategies because of uncertainty of competition (DiMaggio & Powell, 1983)
Alonso-Almeida et al. (2021) <i>Coercive pressures in CE context</i>	The efforts of the EC to foster the CE through directives and plans are considered as coercive pressures (Rodríguez-Anton et al., 2019)
Ranta et al. (2018) <i>Institutional drivers and barriers of CE in EU, USA, and China</i>	<ul style="list-style-type: none"> - Sources for regulative (coercive) pressures: laws, rules, sanctions (high-level, national, state, regional), multiple high-level laws with varying success of enforcement, inconsistent regulation - Sources for normative pressures: certification, accreditation, awards, CE practices/actions are valued
Andrews et al. (2021) <i>IP in adoption of management innovation by local governments</i>	<ul style="list-style-type: none"> - Coercive pressures from regulative bodies and higher levels of government could direct local governments to search for new ways of doing things (Ashworth et al., 2009) - Mimetic pressures from nearby adopters of innovation are also influential (Dixon and Elston 2020) - Normative pressures caused by stakeholder expectations regarding appropriate organisational behaviour (DiMaggio & Powell, 1983)
Alonso-Almeida and Rodríguez-Antón (2020)	<ul style="list-style-type: none"> - Coercive pressures: EU/national/regional legislation

<i>IP in regional context</i>	<ul style="list-style-type: none"> - Normative pressure in the governmental context could be determined by recommendations, guides, or plans from the central government to other lower-level governments - Sources for mimetic imitation: 1) frequency – adopting certain behaviour because all equals are doing it; 2) trait – adopting certain behaviour that other equals are doing which are similar in traits like size, performance, proximity; 3) outcome-based – adopting certain behaviour due to the observed outcome of the ones which adopted it. This is the less probably one because CE regional outcomes are very low or yet non-existent
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Table 29: Studies on institutional pressures in different contexts, used to develop the typology of pressures

Coercive pressures	<ul style="list-style-type: none"> • International and EU legislation • National legislation • Regional legislation
Normative pressures	<ul style="list-style-type: none"> • Interaction with other regional stakeholders (from industry, government, academia, society) and their expectations • International/European/national/regional associations, networks, organisations, advisory bodies • Awards, certification, and accreditation systems the area of circular economy
Mimetic pressures	<ul style="list-style-type: none"> • Adoption of CE policies inspired by other similar regions (in terms of population/ GDP/ development stage etc.) • Adoption of CE policies inspired by neighbouring regions • Adoption of CE policies inspired by other leading regions in the circular economy area

Table 30: Institutional pressures influencing the adoption of CE policies at the regional level – proposed typology

As mentioned, this study uses IT as a theoretical lens, and the theoretical framework developed is shown in **Figure 40**. Through the application of institutional theory, the role that institutional pressure has in the diffusion and adoption of regional CE policies through coercive, normative, and mimetic pressures will be investigated. A particular attention will be given to the S3 strategies, as a type of a normative institutional pressure, and whether they act as a driving force for the transition towards a regional CE, or in contrary they even obstruct the transition of a region in their green transition. Ultimately, an attempt will be made to identify the impact (economic, social, and environmental) that the S3, along with the remaining normative, but also coercive and mimetic institutional pressures have on the regional performance.

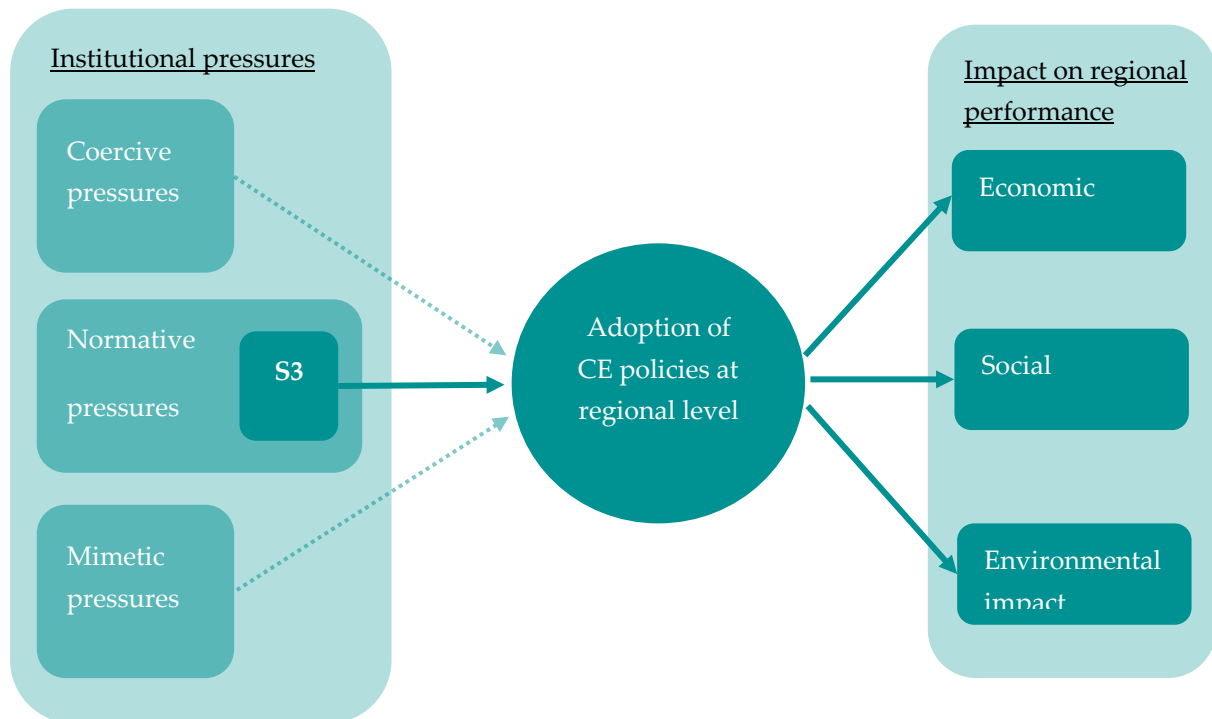


Figure 40: Theoretical framework developed for this research

4.5 Research philosophy

There are numerous definitions of a ‘philosophical paradigm’, but this study adopts that of Wahyuni (2012), according to which a philosophical paradigm is a ‘*set of fundamental assumptions and beliefs as to how the world is perceived which then serves as a thinking framework that guides the behaviour of the researcher*’. These assumptions, made throughout the research process, concern the confronted realities in the research (ontological assumptions), human knowledge (epistemological assumptions), and the degree to which – and ways in which – the researcher’s values influence the research process (axiological assumptions) (Saunders et al., 2019). Carefully considered research assumptions will inform a credible research philosophy, which will underpin the choice of methodologies, research strategies, data collection techniques, and data analysis procedures – all of which reinforces a coherent research project (Kivunja and Kuyini, 2017).

This research study takes a pragmatic philosophical stance. Pragmatism focuses on the research problem and strives to provide applied solutions that inform future practice (Shannon-Baker, 2015). In terms of the multidimensional continua, this philosophy is situated in the middle, aiming to reconcile objectivism and subjectivism. Regarding the ontological assumption, pragmatism considers reality to be the applied consequences of ideas,

concentrating on the flux of processes and practices. The epistemological assumptions that underpin pragmatism concern the problem-solving nature of the research, including the practical application of the solutions and the practical connotations of the knowledge in particular settings. The axiological assumptions relate to its value-driven nature, instigated, and sustained by the beliefs of the researcher and implying a degree of reflexivity (Saunders et al., 2019). Owing to the outcome-oriented aim of this study (**section 4.2**), and the theoretical framework developed in **section 4.4.2** that aspires to produce practical implications, the pragmatic philosophical rationale was deemed the most suitable for this study.

4.6 Approach to theory development

The research approach clarifies the type of relationship between theory and research (Bell et al., 2018). The flexible nature of pragmatism allows the use of a wide range of approaches and methodological choices during the research process. This study takes an inductive approach to theory development, commencing with the collection of data to investigate a phenomenon and generate a theory in the form of a conceptual framework. The focus of this approach is theory generation and building, rather than hypothesis testing, as is the case with the deductive approach. Additionally, the generalisability of findings in the direction from specific to general, is suggesting a small sample is more appropriate while working with qualitative data (Bryman and Bell, 2015). As this study strives to develop a conceptual framework built on the theoretical framework depicted in **Figure 40**, dealing primarily with qualitative data and Policy Delphi findings the inductive viewpoint is deemed the most suitable.

4.7 Research design

According to Saunders et al. (2019), the research design is the overarching plan for how the study will address the research questions. Hence, it contains the methodological choices (**section 4.7.1**), data collection techniques and research strategies (**section 4.7.2**), policy Delphi study (**section 4.7.3**) and data analysis procedures (**section 4.7.4**). The study has an exploratory purpose, seeking to discover the institutional pressures that drive the adoption of regional CE policies, more specifically whether S3 influence the adoption of regional CE

policies; and the research questions, as stated in **section 4.2**, ask *what* and *how*. Moreover, the study is qualitative empirical, gathering primary data from policy Delphi, with several interviews to provide rich, deep contextual data to illuminate the phenomenon in question.

4.7.1 Methodological choice

The study adopted a multi-method (qualitative and quantitative) methodology, with more than one data collection technique and data analysis procedure. In particular, techniques that require quantification of qualitative data were adopted in the Systematic Literature Review (**Figure 41**). Saunders et al. (2019) claim that qualitative research can be undertaken within the pragmatist philosophy, and many varieties of qualitative research begin with an inductive approach to theory development.

4.7.2 Data collection techniques and research strategies

The study employed two streams of data gathering. Initially, secondary data was collected from multiple sources, including reports, action plans, strategies on regional level, online repositories, and websites; and statistical agencies and databases which were analysed as part of the grey literature analysis in **chapter 3**. The data concerned mostly the regional CE policies and S3 strategies, as well as the specific drivers and barriers encountered in each region. Due to the online availability of the data, an archival and documentary research strategy was employed. This strategy has been used increasingly in recent years due to the digitalisation of data, the formation of digital data archives, and the open data initiatives of governments and industries (Saunders et al., 2019).

After the secondary data have been collected and analysed, primary data was collected through policy Delphi method, with regional policy experts, elaborated in **section 4.7.3** in details. Initially, a brief online survey was coded using the Qualtrics software and distributed via email and LinkedIn messages. The purpose of the survey was to gather preliminary information for different EU regions, but more importantly to identify and engage experts in the next stage of the empirical study – the individual interviews.

Considering the exploratory nature of the study, semi-structured individual interviews were selected as the most adequate type of interview for the given research purpose. Semi-structured interviews are typically predetermined allowing uniformity and structured with open-end questions used to guide the discussion between the participant and the researcher. Hence, the participants have more freedom to express their own views on a number of predetermined topics (Saunders et al., 2019). An Interview Protocol was prepared (see **Appendix E**) and followed as a general guide for discussion, though the topics of conversation depended on the background and expertise of each expert, as well as their availability. The duration of the interviews, which depended predominantly on the interviewees' availability, was from 20 to 70 mins. All interviews were conducted online and recorded using the ZOOM platform, where only the lead researcher had access. In total 19 interviews were conducted, resulting in around 13 hours and 20 minutes (or 800 minutes) of recorded conversation. The video-recordings were then transcribed by the lead researcher, using the Word's "dictate" function initially, and refining them manually afterwards. The standard (non-verbatim) transcription style, where the transcripts were lightly edited for the purpose of better readability, avoiding filler words, non-verbal communication, and false starts. All interview transcripts are included in **Appendix G**.

The findings from the survey and interviews were integrated into an initial conceptual framework with seven groups of policy findings, which ultimately was streamlined in a Policy Brief format. The Policy Brief (available in **Appendix J**) was concisely presenting some of the emerging findings overall from the empirical study, grouped in seven distinct policy implications which were interlinked. This was distributed to the participants in the survey and interviews, via mail and LinkedIn messages, in order to present the main findings, but mostly to validate them and potentially uncover some missing elements. In total 43 policy experts were reached in this last stage, and 8 policy experts could not be contacted either because their contact details could not be found, or they have left the regional administration where they were working. Due to the limited time period only 10 experts participated in this final stage.

The study is cross-sectional in its time horizon, and since different data collection approach was used, methodological triangulation was adopted.

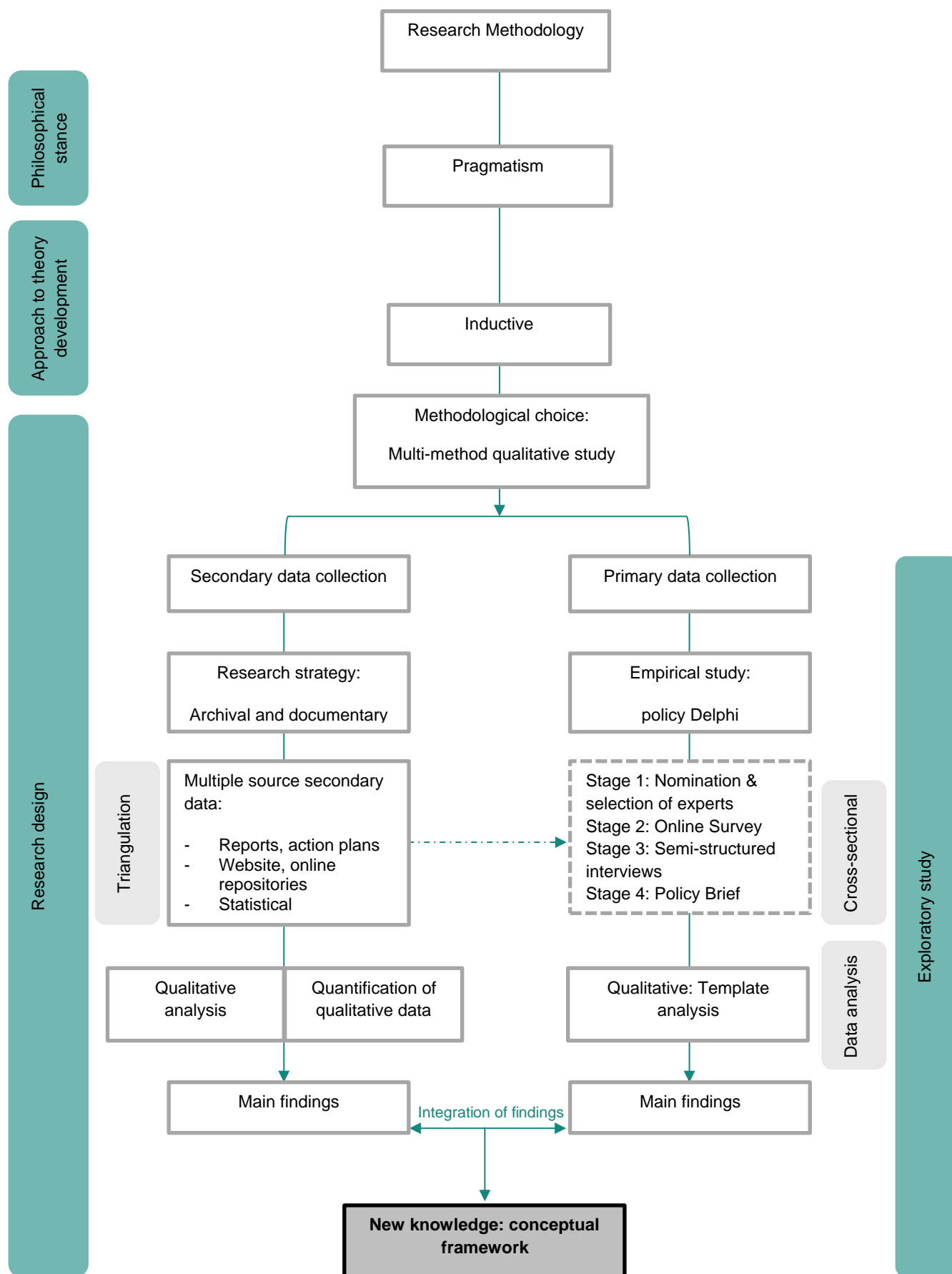


Figure 41: Research methodology

4.7.3 Policy Delphi study

The classical Delphi method appeared in the 1950s as a method that aimed to achieve a consensus among group of experts – called the expert panel (Campbell-Johnston et al., 2021; De Jesus et al., 2019; Okoli and Pawlowski, 2004; van Zolingen and Klaassen, 2003). Whilst different adaptations of the classical Delphi have been developed, in its core this method entails several iterations of questionnaires or discussion rounds with the expert panel (Campbell-Johnston et al., 2021; De Jesus et al., 2019; van Zolingen and Klaassen, 2003).

The policy Delphi, applied when dealing with social and political matters, is deemed more suitable in the social sciences compared to the classical Delphi (van Zolingen and Klaassen, 2003). The method includes collection of data from expert in multiple rounds however, reaching consensus is not the goal as it is with the classical version (Campbell-Johnston et al., 2021; De Jesus et al., 2019; van Zolingen and Klaassen, 2003). The main goal is to generate policy alternatives by adopting a structured public discussion, hence the applicability of this method as an instrument for policy development and promoting participation (Fache', 1993). There is selective anonymity in the process, since the experts are answering the questionnaires individually in the beginning, but they exchange their opinions in a group meeting at the last phase. The expert panel is not selected primarily to ensure representativeness, but rather to engage experts who have a deep and qualified understanding and experience of the topic under research (Campbell-Johnston et al., 2021). Nevertheless, since the final group meeting is aiming to produce a diverse set of perspectives and fundamental arguments, a heterogeneous expert panel needs to be carefully composed (van Zolingen and Klaassen, 2003).

The Delphi method has been applied in the CE literature so far. Campbell-Johnston et al. (2021) adopted a policy Delphi to investigate the outlooks on improving Extended Producer Responsibility (ERP) policies to contribute to the CE targets in the Netherlands. De Jesus et al. (2019) also used policy Delphi method to uncover the CE's core characteristics and evaluate the trade-offs which must be coped with for the transition. On the other hand, Mahanty et al. (2021) and Sharma et al. (2018) use the classical Delphi; the first study to explore the academic perspectives of the CE concept while the second to develop a model of the challenges for

implementing CE-driven sustainability practices in the food supply chains in emerging economies.

As already mentioned before, this study will adopt a policy Delphi method, considering its main aim and deep interlinkage with regional policies. To the best of the researcher's knowledge, no study so far has adopted policy Delphi to investigate the implementation of CE policies in the context of European regions.

The policy Delphi was structured in four interrelated phases (**Figure 42**). **Phase 1** involved the nomination, selection and contacting of the experts which began around November 2021 and was ongoing until August 2022, until the wanted number of respondents of the survey (**phase 2**) was reached. As already elaborated in **section 4.3**, initially, 98 regional policy experts were selected and contacted, following the regional sampling. However, considering the low number of responses to the survey, additional 71 experts were being added on the list and contacted continuously. In total 169 regional policy experts were being reached mostly via email, but also via LinkedIn messages.

In **phase 2** a short online survey was coded using the Qualtrics software and distributed to selected policy experts from **phase 1**. Before distributing the survey to the regional policymakers, an internal pre-piloting was conducted with seven participants within the Project Consortium, in order to test the functionality of the coded survey, the question dependencies as well as the logic of the sections and questions. Afterwards, the re-coded survey was piloted with five academics working in the area of research, with the purpose to ensure the validity of the questions. Their constructive feedback was taken into consideration and the survey was re-coded again, and finally distributed to the regional policymakers. The online survey contained four main sections (see **Appendix D**). **Section A** was asking for the experts' background information and the efforts of their regions towards the CE transition. **Section B** was devoted to the S3 strategies of the region, and their relationship with the regional CE policies. **Section C** was trying to capture the attempts of the regions for measuring the progress towards the CE, while **section D** to identify the most influential institutional pressures influencing the regional CE policies. The nine statements within this section were grouped into coercive, normative, and mimetic pressures, based on the proposed typology which emerged from the literature review (**section 4.4.2, Table 30**). The questions in **section**

B were corresponding to RQ1, the questions in **section C** were targeting RQ2 while the questions in **section D** were aiming to address RQ3. This phase started on 12th May 2022 and was closed on 12th September 2022. In total 42 experts responded to the survey, representing 20 EU countries and 32 EU NUTS 2 regions, out of which 21 regions were the ones identified with the regional sampling (**section 4.3**). The full list of experts which responded to the online survey is available in **Appendix C** of this report.

In the online survey, the experts had the opportunity to express their interest to participate further in the research, by agreeing to take part in an individual interview. Hence, in **phase 3**, semi-structured individual online interviews were organised with 19 experts, which aimed to tackle the hidden complexities of the area of research, which could not be captured in the survey. Ten (10) experts which responded to the survey also participated in the interviews. In two cases the participants of the survey suggested their colleague to participate in the interview, and the remaining 7 participants were recruited subsequently using a snow-balling technique, to mobilise additional knowledge, each one of them in their area of expertise. It has to be noted that not all of the experts were regional policymakers; some were policy analyst or directors working in EU institutions, eminent academics in the field of environmental sciences and regional development policies, project managers. The full list of the interviewees and their position is listed in **Table 31**, while the full list of experts which participated in all stages of the policy Delphi study is available in **Appendix C** of this report.

All interviews were conducted virtually using the ZOOM platform. The main aim of the interviews was to discuss the results of the survey and gain deeper and more contextual information regarding the researched areas. Therefore, an Interview Protocol was prepared which served as a general guide for the discussions, comprised of five sections (see **Appendix E**). **Section A**, focusing on the regional CE policies, was intended to set the ground for the discussion, asking some general questions. **Section B** had the purpose to uncover the links between S3 and regional CE policies, where the researcher by presenting some of the survey results attempted to identify potential risks between these two policies and mitigation mechanisms. In **section C** the measuring and monitoring efforts and frameworks were mainly discussed, including the data availability issue. **Section D** was devoted to the institutional pressures influencing the adoption of CE policies across EU regions, and here again the researcher presented some of the survey results in order to start the discussion. The last

section, **section E** was related to the multi-level governance mechanisms and division of power among EU Member States, as an important factor which inevitably influenced the formulation of CE policies at regional level.

The interviews were organised as semi-structured, hence for each of the participant the length and focus of the discussion were varying. Details regarding the consent forms can be found in **section 4.8** and **Appendix F**. Before each interview the researcher was familiarising with the background and field of expertise of each participant, in order to tailor make each Interview Protocol and each Power Point Presentation used as tools to assist the process. Overall, the researcher was guiding the conversation with open-ended questions, attempting to allow enough freedom to the participant to express their own perspectives concerning certain matters, and potentially bring to the surface other related issues to be considered. However, when needed, specific sub-questions were asked in cases where the participant was not elaborative enough. Considering that the interviewing stage lasted 7 months, during the last interviews the researcher was presenting the preliminary findings from the interviewing stage as well, asking the feedback of the participants on those issues also. After the 19th interview, the researcher, consulted with the Supervisory team, considered that a saturation point is reached, no major novel findings were emerging and the existing ones were validated, hence this phase of the policy Delphi study was closed. As already mentioned in **Figure 42**, this phase started on 30th September 2022 and ended on 7th April 2023.

In the last phase, **phase 4**, a Policy Brief was developed with the main findings of the study and circulated for validation. The initial idea was to organise a final group interview in order to present the findings, but due to time constraints and the summer period where the majority of the contacted experts were on a leave, it was very challenging to organise such an event. Therefore, it was decided the findings from the survey (**phase 2**) and the interviews (**phase 3**) to present them in an initial version of the conceptual framework with seven main propositions. Consequently, these findings were condensed in a Policy Brief format with seven groups of policy implications. These included, 1) the regional narrative in the CE transition, 2) institutional pressures driving the regional CE policy formulation and implementation, 3) formulation and implementation of regional CE policies, 4) S3 and CE policy nexus, 5) regional CE hubs (networks), 6) Partnerships for Regional Innovation (PRI) initiative and 7) tracking the regional performance. The Policy Brief was then distributed to

43 policy experts which participated in one or both previous phases of the study, survey (**phase 2**) and interviews (**phase 3**). The experts were contacted via email and LinkedIn messages, offering them the chance to reply to the mail providing their feedback, to schedule a brief online discussion if this was more preferred, or in case they would not come back in the provided time period the researcher team will consider that they are in a broad agreement with the presented findings. As already mentioned in **Figure 42**, this phase started on 6th July 2023 and ended on 16th July 2023. In total, 10 experts provided feedback, 9 through mail and one through an online discussion which was subsequently transcribed. The feedback was collected, and the validated version of the Policy Brief is available in **Appendix J**.

The applied data analysis procedures are explained in **section 4.7.4** and **4.7.4.1** while the findings from every phase of the policy Delphi study are presented in **chapter 5**.

Phase 1: Nomination, selection and contacting experts November 2021- August 2022	<ul style="list-style-type: none"> • 169 regional policy experts contacted in total • Reached mostly via email and LinkedIn messages • This phase lasted 10 months, due to the difficulty to find the right experts, at the relevant position and level, willing to participate in the study
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Phase 2: Online survey 12/05/2022- 12/09/2022	<ul style="list-style-type: none"> • Internal Pre-Piloting within Project Consortium (7 participants) • Piloting with Academics working in the field (5 participants) • Distribution of final online survey to high-level regional policymakers (42 participants) <ol style="list-style-type: none"> 1. Section A: Background information 2. Section B: Smart Specialisation Strategies (S3) (RQ1) 3. Section C: Measuring progress towards CE (RQ2) 4. Section D: Institutional pressures influencing regional CE policies (RQ3)
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Phase 3: Semi-structured individual interviews 30/09/2022 – 07/04/2023	<ul style="list-style-type: none"> • 19 participants responding to open-ended questions • Online discussion using ZOOM platform to conduct and video record the interviews • Interview protocol including five main sections: <ol style="list-style-type: none"> 1. Section A: Regional CE policies 2. Section B: Smart Specialisation Strategies (S3) and regional CE 3. Section C: Measurement systems/Monitoring frameworks 4. Section D: Institutional pressures influencing regional CE policies
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	5. Section E: Mechanisms (multi-level governance and division of powers)
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Phase 4: Policy Brief distribution 06/07/2023 – 16/07/2023	<ul style="list-style-type: none"> • 10 participants provided feedback, validating the Policy Brief • Validate the main emerging findings presented in the Policy Brief • Policy Brief including seven main group of findings in a form of policy implications: <ol style="list-style-type: none"> 1. The regional narrative in the CE transition 2. Institutional pressures driving the regional CE policy formulation and implementation 3. Formulation and implementation of regional CE policies 4. S3 and CE nexus 5. Regional CE hubs (networks) 6. Partnerships for Regional Innovation (PRI) initiative 7. Tracking the regional performance
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Figure 42: Policy Delphi process

No.	Date of interview	Participant	Role/Organisation	Region/Country	Notes/Selection criteria
I1	30.09.2022	MR	Assistant Professor, Universidad de Vigo, Spain; Member of the CE Commission of the Regional Administration of Galicia	Galicia, Spain	Academic with expertise in policy formulation - contributed to the development of the Galician Circular Economy Strategy 2020-2030 for the Galician Regional Government
I2	05.10.2022	VR	Research Fellow and Head of Sustainable Resources and CE, Centre for European Policy Studies (CEPS)	Brussels Capital Region, Belgium, but EU wide perspective	Research fellow and managerial position in CEPS, Brussels, following the EU debate regarding CE transition, good knowledge of EU policy frameworks and structures, but not specialised on regional policy matters
I3	13.10.2022	CF	EU Project Manager, Marche Agriculture Fisheries – Agency for Innovation in the Agri-food and Fisheries sector	Marche Region, Italy	Project Manager of EU projects, focused mostly in the agricultural sector, but has knowledge of CE and S3
I4	14.10.2022	HJ	Development Consultant, Circular Economy Beyond Waste, Regional Development	Central Denmark Region, Denmark	Consultant on circular economy and regional development
I5	11.11.2022	IF	Director of the Bioeconomy and Environment Cluster (CLuBE); Member of the European Bioeconomy Panel of the EC (DG RTD)	Western Macedonia, Greece	Working in the area of Bioeconomy, representing the cluster, so industrial actors, not a policymaker
I6	11.11.2022	DC	Former Senior Official (Head of Unit), European Commission; Friends of Smart Specialisation; Regional Studies Association (RSA)	Brussels Capital Region, Belgium but EU wide perspective	High-level policy expert, worked in the EC on policies related to S3, regional development policies and sustainability/CE
I7	16.11.2022	MS	Head of Division/Professor, Mineral and Energy Economy Research Institute of the Polish Academy of Sciences	Malopolskie Region, Poland	Academic working in a research institute supporting the ministries and regional institutions in implementing some CE solutions, but not a policymaker
I8	18.11.2022	CM	Project Manager for Circular Economy, Business Upper Austria, OO. Wirtschaftsagentur GmbH	Upper Austria, Austria	Regional policy expert in circular economy, especially in plastics value chains and new business models

I9	21.11.2022	CK	Head of Department, Regional Development Fund of Central Macedonia	Region of Central Macedonia, Greece	Regional policy expert in S3
I10	22.11.2022	AC	Panel Member, United Nations Environment International Resource Panel (UNEP IRP); Development Council Member and Secretary, International Society for Industrial Ecology; Past President, Asia Pacific Roundtable for Sustainable Consumption and Production; Professor, De La Salle University	Philippines, but having an International and EU perspectives	High-level policymaker with expertise on policymaking in the area of sustainability, but aware of the main challenges and the high-level policy situation in the EU with respect to the CE
I11	24.11.2022	MM	General State Counsellor, Ministry of Investments, Regional Development, and Informatisation of the Slovak Republic	Western Slovakia, Slovakia but presenting Slovakia overall	Policymaker on the national level, but has knowledge of the regional situation
I12	28.11.2022	PMC	Chair of Urban and Regional Economics at Alliance Manchester Business School, previously Special Adviser to two EU Commissioners for Regional Policy; regularly works with international organisations like OECD, United Cities and Local Government, the European Investment Bank, the EC, and government bodies in various countries, like JRC Seville on S3/S4 policies	EU wide perspective	Prominent academic which works with EC in the area of regional development, regional innovation systems, S3/S4 policies and the need to include sustainability concepts in the policy frameworks
I13	30.11.2022	AVDS	Strategist, Circular Transition - Province Zuid-Holland	South Holland, The Netherlands	Regional policy expert in CE
I14	09.01.2023	AH; GP	Community Manager, European Commissions' Circular Cities and Regions Initiative (CCRI); Policy and Project Manager, European Regions Research, and Innovation Network (ERRIN),	EU wide perspective	Community Management of the CCRI CSO Coordination and Support Office
I15	10.01.2023	LP	Manager of UN SDSN Greece and EIT Climate-KIC Hub Greece	Greece overall	Working as a researcher in different institutions and being involved in various projects in Greece, expertise resides in the area of S3 and CE mostly, not a policymaker
I16	20.01.2023	TW	Director for Legislative Works (Regional Policy, Economic Affairs, Employment, and Innovation), European Committee of the Regions (CoR)	EU wide perspective	High-level policy maker at the EU level within CoR, involved in the PRI initiative

I17	27.01.2023	TFS	Head of the Economic Promotion Unit at the Government of Catalonia's Ministry of Economy and Finance	Catalonia, Spain	Coordinating the Research and Innovation Strategy for the Smart Specialisation of Catalonia (RIS3CAT), regional policy expert in S3
I18	03.03.2023	DP	Economist at the Territorial Development Unit of the Directorate for Growth and Innovation, Joint Research Centre (JRC) Seville, EC	EU wide perspective	Policy analyst specialised in S3/S4, regional development and PRI initiative
I19	07.04.2023	LP	Secretary and Program Manager, Holland Circular Hotspot	Holland, The Netherlands	Manager at CE hub at regional level (not NUTS 2 level, Holland is North Holland and South Holland which are NUTS 2 regions/provinces)

Table 31: Conducted interviews and participants

4.7.4 Data analysis procedures

The interview transcripts were analysed using Template Analysis (TA), as one of the qualitative approaches for data analysis preferred by researchers who are pragmatists (Tabari et al., 2020). TA encompasses the development of a coding 'template', summarising the themes determined by the researcher as relevant in a data set, and arranging them in a purposeful manner (Brooks and King, 2014). TA, as a type of Thematic Analysis, is deployed in a wide range of research studies in social sciences, where the data sets are usually in a form of interview transcripts (Tabari et al., 2020; Brooks et al., 2015; Brooks and King, 2014). Themes are reiterative traits brought up by the participants which the researcher deems are important to the research questions, while the process of identifying the themes in the data set and labelling them (setting a code) is known as coding. The themes are arranged in template, in a purposeful way to show the links between different themes and sub-themes (Brooks and King, 2014). Another characteristic of the TA is the iterative nature and systematicity of the process, which certainly is time consuming; but ultimately avails the researcher to continuously review the development, modification, and interrelation of the themes, allowing also to keep an audit trail of the template development (Tabari et al., 2020).

In terms of coding approaches, hierarchical coding was applied, meaning narrower more specific themes were nested into broad overarching themes. Considering the flexibility of TA in terms of the depth of coding, the researcher is encouraged to code areas of text which are rich in depth (Tabari et al., 2020). Hence, in some themes up to six levels of coding can be encountered within the template, in order to capture the richest and most detailed aspects of the data (Brooks et al., 2015). Parallel coding was also applied where deemed appropriate, implying same segment of text was categorised within more than one different code and theme (Brooks and King, 2014). The coding was performed manually using MS Word, due to the low number of interviews.





The use of *a priori* themes is permitted within the TA, though it is not a necessity, meaning that if considered beneficial the researcher can identify before the main analysis potentially useful themes (Tabari et al., 2020; Brooks and King, 2014). In this study a mixed approach was used, combining the deductive nature of the *a priori* themes emerging from the academic

literature, grey literature, and survey results on one hand, and the new themes emanating from the interviews on the other hand, representing the inductive nature of the process.

4.7.4.1 Procedural steps for Template Analysis

The procedural steps followed in a TA are flexible, allowing to be modified in order to suit the specific needs of different studies. The main steps are adjusted from Tabari et al. (2020), Brooks et al. (2015) and Brooks and King (2014) and illustrated in **Figure 43**. In **step 1**, the researcher became familiar with the dataset, by reading in detail all interview transcripts. In **step 2** preliminary coding was performed comprised from two phases. In the first phase a deductive clustering was performed using the *a priori* themes identified from academic literature review (**chapter 2**), grey literature analysis (**chapter 3**), underpinning theoretical frameworks (**chapter 4**) and survey results (**chapter 5**). As a result of this deductive clustering an initial template (V1) was developed with 4 main themes. Subsequently in phase two, a sample of 8 out of 19 interviews was selected for inductive coding, where sections of text which seemed relevant were highlighted and coded. The sequence and reasons for selection are stated in **Figure 43**. In **step 3** the emerging themes were organised into meaningful clusters, using the selected sample of 8 interview transcripts. At this stage (**step 4**) the clusters were defined sufficiently so as to be organised into a modified template (V2), where themes and sub-themes were defined as precisely as possible and short description of the main themes were provided for clarity. In this stage the template (V2) had 8 main themes, and it was further used in **step 5** to code additional 5 interview transcripts. Taking into consideration the iterative nature of the process, themes and sub-themes were re-coded and modified, ultimately leading to V3 of the template with 8 main themes. The last 6 interview transcripts were coded in **step 6**, modifying the existing themes and template, and defining the final template V4. Nevertheless, the researcher deemed necessary to streamline the template by reshuffling some of the themes and introducing two new themes for greater clarity. Therefore, in last **step 7** a final template V5 was developed comprising 10 themes, and all interview transcripts were aligned to this final template. It is worth noting that only the last code was kept in the interview transcripts in most of the cases, except if the response was also contributing to identify higher level codes, where the necessary length of the hierarchical

coding was kept. The final template V5 is available in **Appendix H**, while a sample of three coded interview transcripts was selected and included in **Appendix I**. The analysis and interpretation of the interviews using the final template and comprising themes and sub-themes is presented in **section 5.3**.

Step 1: Familiarisation with the data	<ul style="list-style-type: none"> • Reading in detail all 19 interview transcripts (19/19)
	
Step 2: Preliminary coding	<ul style="list-style-type: none"> • Phase 1: Deductive clustering & development of initial template V1 <ul style="list-style-type: none"> ◦ Deductive approach: <i>a priori</i> themes identified from academic literature review (Ch. 2), grey literature analysis (Ch. 3), underpinning theoretical frameworks (Ch. 4) and survey results (Ch. 5) ◦ Initial template V1 developed with 4 main themes • Phase 2: Inductive coding of selected sample of 8 interview transcripts (8/19) <ul style="list-style-type: none"> ◦ Sequence of interview transcripts for analysis and selection reason: 1.TA - MM (I11 - lagging behind region), 2.TA - LP (I15 - lagging behind region), 3.TA - IF(I5 - lagging behind region), 4.TA - CM (I8 – transitioning region), 5.TA - DC (I6 – EU policy-making), 6.TA - PMC (I12 – S3/CE links, EU level), 7.TA - AVDS (I13 – advanced region), 8.TA - TFS (I17 – advanced region)
	
Step 3: Clustering	<ul style="list-style-type: none"> • The coded themes from the selected sample of 8 interview transcripts were clustered in order to identify relationships and links (8/19)
	
Step 4: Developing the initial template V2	<ul style="list-style-type: none"> • The inductive clustering of the themes from the selected sample of 8 interview transcripts (8/19) resulted in modification of the initial template • Initial template V2 developed with 8 main themes
	
Step 5: Apply initial template to further data & modify V3	<ul style="list-style-type: none"> • Additional coding of 5 interview transcripts (13/19) was performed • Sequence of interview transcripts for analysis: 9.TA - CK (I9), 10.TA - MS (I7), 11.TA - CF (I3), 12.TA - AC (I10), 13.TA - VR (I2) • Modified template V3 developed with 8 themes

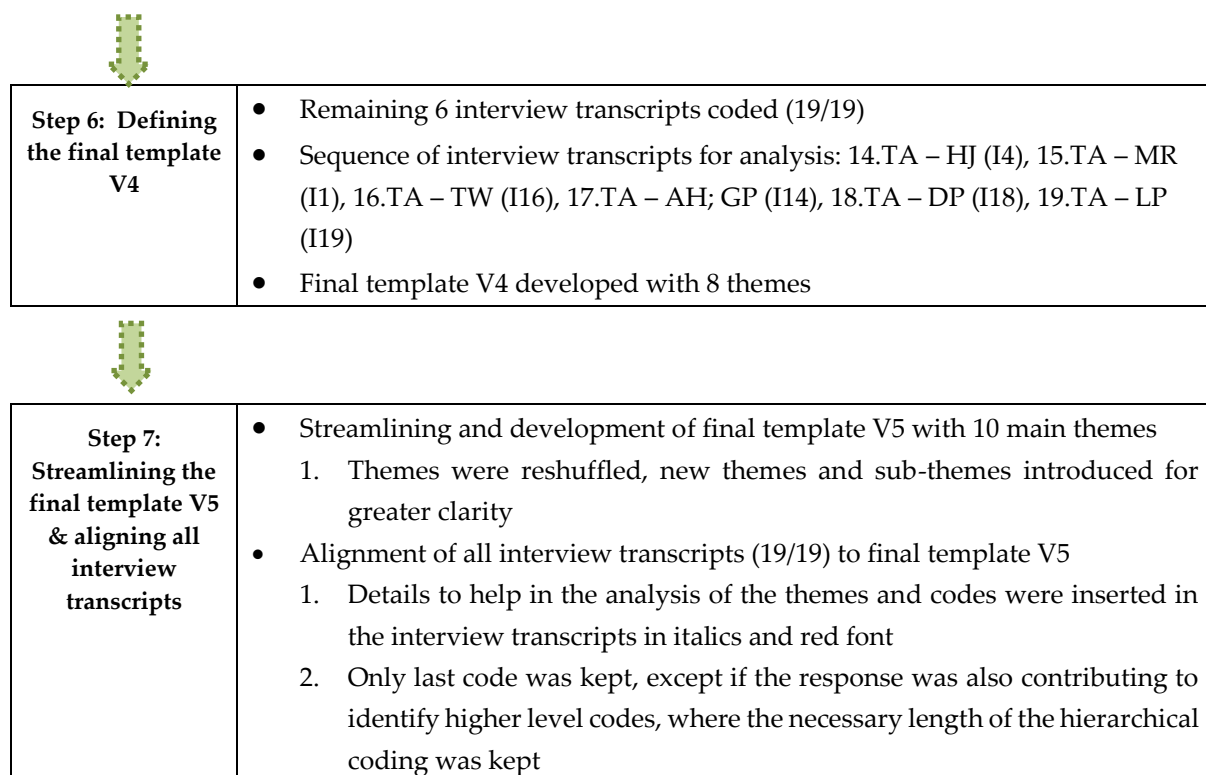


Figure 43: Procedural steps for TA

4.8 Research ethics and considerations

The critical issues concerning integrity and ethics have been diligently considered during the planning, undertaking and dissemination of the research. This encompassed the mitigation of potential risks and appropriate reassurance of confidentiality (McKenna and Gray, 2018). As this research gathered information from participants (during the policy Delphi study), a research ethics application was sent online to the Sheffield University Management School ethics committee and approved on 22nd November 2021. There were no notable ethics issues identified and faced throughout this study, except the global COVID-19 pandemics which constraint the researcher to gather in-person primary data, hence the data collection was organised and conducted fully online.

Participant Information Sheet was provided to all participants beforehand, to provide information regarding the study and terms of participation, with an option to withdraw from the research without any explanation (**Appendix D** and **Appendix F**). More importantly, Consent Form was provided for the online survey (**Appendix D**), and for the interviews there were two instances: 1) the participants which agreed during the survey to participate in the interview stage were reminded regarding the terms of participation in written form via mail

and 2) the newly recruited participants were asked to fill in an additional online Consent Form (**Appendix F**). In both cases the participants were asked to confirm their agreement to audio and video record the discussion for the transcription purposes.

Furthermore, this research project is part of a European Union Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Innovative Training Networks (H2020-MSCA-ITN-2018) scheme (ReTraCE project, grant agreement number 814247), and the ethical principles of the project and the beneficiary institution (the South-East European Research Centre) have been followed. Finally, the researcher has actively engaged with the compulsory RCS6100 research ethics and integrity module.

4.9 Limitation of the methods

A number of caveats need to be noted regarding the chosen methodology of the study. First of all, the constraints related to the manual search on Google for existing regional policies related to CE need to be mentioned, since unintentional omissions of information might have occurred. The researcher relied on the availability of information in English language on the web, which in some cases might not represent the actual reality, i.e., a region might have internally devised a CE strategy, but not be available on the internet. Additionally, the language barrier might have caused some accidental lapses. Another source of weakness is inherited by the Eye@RIS3 tool itself. It must be considered that the tool is attempting to resemble the definition of priorities based on their description in the strategy documents, considering the different approaches of innovation priority setting in EU regions and countries. This implies that some approximation is used by the tool, but also it highlights the reliance of the tool on the timely update of related information from the side of the regional authorities in charge of the strategic documents.

Secondly, the limitations related to policy Delphi method and the expert panel need to be mentioned. The panel selection is vital for the success of any Delphi study (Okoli and Pawlowski, 2004), and since the loss of participants in each round can reduce the richness of the data (Campbell-Johnston et al., 2021), the researcher intentionally decided to have only 3 phases, despite the first phase which is the selection and nomination of the participants. Moreover, one must consider the subjectivity of the experts' answers, and the possibility they

might not approach the questions and the discussion from a neutral perspective (Campbell-Johnston et al., 2021). Lastly, the reliability of the Delphi method in general has been criticised in the literature (Woudenberg, 1991; Sackman, 1975), because of the circumstantial and personal features concomitant with one round of the Delphi method.

Thirdly, the limitations inherited to the Template Analysis (TA) must be acknowledged. The concentration of efforts throughout the process on devising the coding structure might give the impression that the template per se is the ultimate aim of the analysis, rather than to be perceived as means to avail rigorous and compelling analysis of the data (Tabari et al., 2020). This implies that the focus of TA is predominantly a cross-case instead of a within-case analysis, leading to potential consequences such as inevitable loss of comprehensive understanding in relation to individual accounts (King and Brooks, 2017; Brooks et al., 2015)

Chapter five: Results and Discussion

5.1 Introduction

Chapter 4 detailed the research methodology and approaches selected for this research, as well as the procedures involved in conducting the data collection and data analysis. The theoretical framework, which provides a worldview or lens that employs knowledge from existing research to make sense of the data in the new study was also introduced. Namely, institutional theory (IT), the theoretical lens applied in this study, was briefly explored, along with an explanation of how this theory will inform the research. Finally, the four-phase policy Delphi method designed particularly for this study, was introduced in detail. *Phase 1* involved the nomination, selection and contacting of the experts. In *Phase 2* a short online survey was distributed to the policy experts through the Qualtrics software. During *Phase 3*, semi-structured individual online interviews were organised with 19 experts, which aimed to tackle the hidden complexities of the area of research, which could not be captured in the survey. In the last phase, *Phase 4*, a Policy Brief with the main emerging findings was distributed to the participants in the previous two Phases, in order to validate the results. This chapter therefore presents the results and analysis from the primary qualitative data collected from the policy Delphi method. The results from the online survey are analysed in **section 5.2**, the emerging findings from the individual interviews are presented in **section 5.3** and the validated Policy Brief are elaborated in **section 5.4**. A discussion section follows (**section 5.5**) where the conceptual framework which emerged from the findings of the primary data collection will be present and discussed, containing more complexities regarding the relationships which are being explored in this research.

5.2 Online survey – analysis and discussion of results

As already mentioned above, and explained extensively in **section 4.7.3**, the online survey contained four main sections (see **Appendix D**). The results from **section A**, which was asking for the experts' background information and the efforts of their regions towards the CE transition, are presented in **section 5.2.1**. **Section B** was devoted to the S3 strategies of the region, and their relationship with the regional CE policies, and the related results are shown

in **section 5.2.2. Section C** was trying to capture the attempts of the regions for measuring the progress towards the CE, while **section D** to identify the most influential institutional pressures influencing the regional CE policies. The pertinent results were analysed in **sections 5.2.3 and 5.2.4** respectively. **Section 5.2.5** is highlighting the main findings from the survey overall, and the areas which require further investigation in the interview stage. In total 42 experts responded to the survey, representing 20 EU countries and 32 EU NUTS 2 regions, shown in **Table 32**. From the 32 regions, 21 regions were identified from the regional sampling as elaborated in **section 4.3** and showed with red boxes in **Table 32**, and additional 11 regions were identified. The majority of regions (24 in total) were represented by 1 policy expert, while six regions were represented by 2 policy experts (Upper Austria, Western Macedonia, Tuscany, Luxembourg, Catalonia, and South Holland). Brussels Capital Region and the Region of Central Macedonia were represented by 3 policy experts. The most represented country was Greece with 4 regions, followed by Belgium, Italy, and Spain with 3 regions and Denmark, Finland, and The Netherlands with 2 regions. The full list of experts which responded to the online survey is available in **Appendix C** of this report.

Country	Region	Number of respondents
Austria	Upper Austria	2
Belgium	Brussels Capital Region	3
	Flanders	1
	Wallonia	1
Cyprus	Cyprus	1
Czech Republic	Prague	1
Denmark	Capital Region	1
	Central Jutland Regions (The Central Denmark Region)	1
Finland	East and North Finland	1
	West Finland	1
France	Pays de la Loire	1
Germany	Weser-Ems	1
Greece	Region of Central Macedonia	3
	Western Macedonia	2

	West Greece	1
	Eastern Macedonia and Thrace	1
Hungary	North Great Plain Region	1
	Emilia-Romagna Region	1
Italy	Tuscany	2
	Marche Region	1
Lithuania	Capital Region	1
Luxembourg	Luxembourg	2
Poland	Malopolskie	1
Portugal	Madeira	1
Romania	North-East Region	1
Slovakia	Western Slovakia	1
	Galicia	1
Spain	Basque Country	1
	Catalonia	2
Sweden	Stockholm	1
	Friesland	1
The Netherlands	South Holland	2

Table 32: Surveyed NUTS 2 regions and number of respondents per region

5.2.1 Section A: Background information

The **section A** of the survey was intended to gather the contextual information regarding the existing CE policies (strategies, actions plans) of the surveyed regions, as well as the perceived level of CE adoption. 24 experts, representing 19 regions, stated their region has circular economy dedicated initiatives. 14 experts, representing 13 regions, stated their regions don't have a regional CE policy, while 4 experts, representing 3 regions, didn't know if their region has a CE policy (**Figure 44**). It is interesting to mention that on three occasions, different experts from the same region gave different answers to this question. This was the case for Tuscany (1-Yes, 1-I don't know), Upper Austria (1-Yes, 1-No), and Region of Central Macedonia (2-No, 1-Yes). This explains the total number of 35 regions mentioned above,

instead of the 32 which is the actual number of surveyed regions, since the researcher was unable to situate the region only in one category based on the expert's answers.

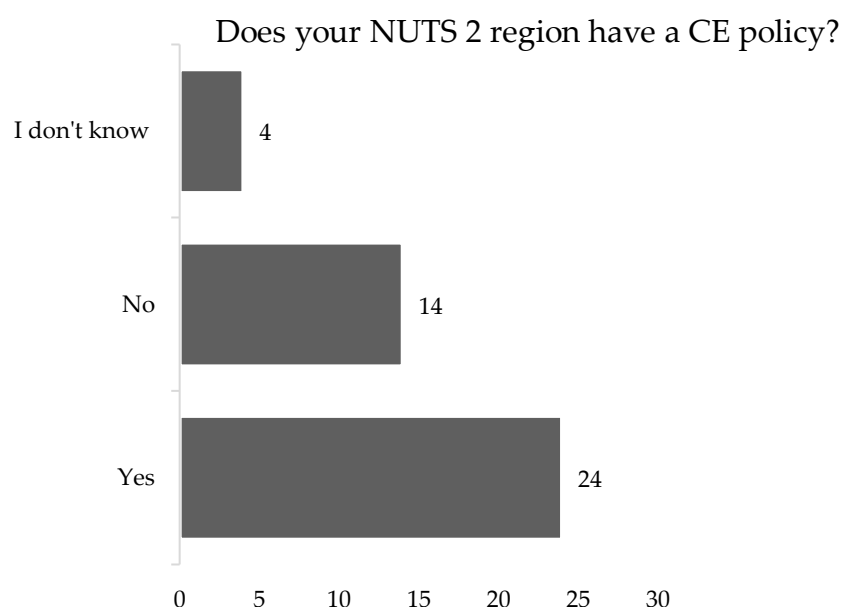


Figure 44: Share of surveyed experts regarding the existence of regional CE

Several surveyed regional governments have already developed CE policies, which have been listed in **Table 33**. The majority of them are standalone documents specifically addressing CE, but in some instances, they are part of a wider sustainability strategies like it is the case with the Central Denmark Region, Flanders, Upper Austria or in the case of East and North Finland part of the Smart Specialisation (S3) Strategy 2019-2023. In terms of publication years, the earliest policy efforts can be observed in 2015 in Friesland, Catalonia, and Emilia-Romagna Region, followed by Brussels Capital Region and Flanders which developed their respective policy documents in 2016. The latest strategy developed in 2022 is Prague's' CE strategy, while it is foreseen three other regions to finalise their regional CE policies by the end of 2022. *The Circular Economy Roadmap for Catalonia* is under development to be finalised in third or fourth quarter of 2022. Emilia-Romagna Region was the first region in Italy to adopt a specific CE policy in 2015 in a form of Regional Law n.16/2015 which will be updated in 2022 in order to become fully adherent to the European and national legislation that has developed since 2015. Lastly, the region of Tuscany, adopting a participatory path for the development process of the *Regional plan of the circular economy and remediation* is expected to conclude the policy by the end of 2022. It is worth noting that the expert from the Capital Region (Lithuania) even

though stated the region has a regional CE policy, didn't provide the title nor the link to it, hence it was excluded from this particular analysis.

The surveyed regional governments have been establishing a circular economy long-term vision. These have taken various forms, such as: strategies (Luxembourg, Central Denmark Region, Wallonia, Catalonia, Prague, Galicia, South Holland, East and North Finland, Flanders, Upper Austria, Basque Country); action plans (Region of Central Macedonia, Pays de la Loire); plans (Tuscany); roadmap (Catalonia); agenda (Madeira); program (Brussels Capital Region); regional law (Emilia-Romagna Region) or policy report (Friesland).

Different circular-related objectives and targets are set in these regional policies, some of them vaguer while some very specific. For instance, the *Basque Country Circular Economy Strategy* (2020) sets three strategic objectives: 1) to increase material productivity by 30%; 2) to increase the rate of use of circular material by 30% and 3) to reduce by 30% the rate of waste generation per unit of GDP. Additionally, the strategy includes two complementary objectives to this last objective in relation to two of the trends prioritised by the European Commission, which are: reduce the generation of food waste by 50% and ensure that 100% of plastic containers are recyclable. The *Brussels Regional Program for a Circular Economy 2016-2020* (2016) has three general objectives: 1) to transform environmental objectives into economic opportunities; 2) to relocate the economy to Brussels in order to produce locally whenever possible, reduce travel, optimise land use, and create added value for Brussels citizens and 3) to support employment. In the upcoming *Regional plan of the circular economy and remediation* Tuscany's objectives are to improve and increase separate waste collection, reaching a regional average of 80-85% by 2035, but also recover at least 65% of material in the context of recycling and reuse.

In the *Sustainability Strategy 2030 for Central Denmark Region* (2021), the vision is to be a circular region with sustainable procurement, reuse, recycling, renewable energy, and minimal consumption in 2030, and in 2050 to be CO₂ neutral. CE is one of the 4 main areas of this wider strategy of the region with the following specific goals by 2030: 1) 30% reduction in use of resources in procurement and daily operations; 2) 30% reduction in waste and 3) 70% recycling of waste. South Holland aims to be 100% circular by 2050 (Strategy Circular South Holland: Accelerate Together, 2019), while Friesland is determined to be one of the most

circular regions in Europe by 2025, hence providing an example for the next generation (Circulair Fryslân: De Economie Van De Toekomst, 2015). With its *Circular Prague 2030* strategy (2022), the Czech capital is dedicated to steadily decrease its carbon footprint and the need for primary raw materials, while transitioning towards carbon neutrality in 2050. In the business and research strategy *#upperVISION2030* (2020), the region of Upper Austria is focusing on smart specialisation and the transmission of research outcomes into business practices. In terms of sustainability, the vision of the region by 2030 is to be perceived as an industrial region that acts sustainably and that people want to live in.

The main objective of the *Action Plan for promotion of the circular economy in SMEs of the Region of Central Macedonia* (2018) is to influence the available policy instruments towards the CE transition, particularly concentrating on the Regional Operational Programme (ROP) of the region. The Action Plan has three main axes: 1) specialisation of the RIS3; 2) incorporation of the CE actions into the ROP of Central Macedonia 2014-2020 and 3) implicit incorporation of the issues of circular economy into the ROP of the programming period (2021-2027) and its funding priorities.

With the law from 2015, French regions are capable to devise regional plans for waste prevention and management. In light of this, in 2019 the Pays de la Loire region devised its Regional Waste Prevention and Management Plan and the Circular Economy Action Plan (Regional Action Plan for the Circular Economy 2018-2025, 2019).

The long practice of co-operation among the regions of East and North Finland (ENF) culminated in early 2018, when the ENF regions participated in one of the EC's pilot areas, called, Regions in Industrial Transition (ELMO), to develop new approaches based on S3. The first collaboration phase resulted in the *East and North Finland in industrial transition - smart specialisation strategy 2019-2023* (2019).

In the case of Flanders and Friesland the actual website developed by the regional authorities represents the main hub and the inspiration for CE transition. In 2016 the regional government of Flanders launched the *Vision 2050: A Long-Term Strategy for Flanders* (2016) for an inclusive, open, resilient, and internationally connected region that creates prosperity and well-being for its citizens in a smart, innovative, and sustainable manner. In this context, the CE was one of the seven transition priorities, while the Circular Flanders (<https://vlaanderen->

circulair.be/en) was acting as the main hub and partnership of governments, companies, and civil society. The report for Friesland region published in 2015, analysing the regional raw material flow, revealed the opportunities for the Frisian economy. This led to the establishment of the Circular Friesland Association in 2016 (Circular Friesland - <https://circulairfriesland.frl/>).

One of the most peculiar cases in the transition are certainly the islands. The islands and outermost regions are more reliant on resource imports, more susceptible to supply chains disturbances and sensitive to external threats. Additionally, the lack of scale is constraining the expansion of certain economic activities, resulting in specialisation based on services, like the tourism. These challenges can, however, augment the advantages of adopting CE practices. The Regional Government of Madeira followed this path, making a commitment to circularity in their *Circular Madeira 2030* agenda (2021), Resolution no.144/2021. This agenda is aligned with European guidelines without losing sight of the specific challenges and opportunities of the Autonomous Region of Madeira.

Region	CE policy	Link	Year
Luxembourg	Circular Economy Strategy Luxembourg	https://economie-circulaire.public.lu/en/publications/circular-strategy.html	2021
Friesland	Circulair Fryslân: De Economie Van De Toekomst	https://www.fryslan.frl/circulaireconomie	2015
Central Jutland Region	Sustainability Strategy 2030 for Central Denmark Region	https://www.rm.dk/siteassets/om-os/english/sustainability-strategy/rm---strategi-for-baredygtighed_uk_enkelt_tilgangelig.pdf	2021
Wallonia	Circular Wallonia, circular economy deployment strategy	https://economiecirculaire.wallonie.be/situation-regionale	2021
Catalonia	1.Strategy to promote the green economy and the circular economy 2.Circular Economy Roadmap for Catalonia	https://mediambient.gencat.cat/es/05_ambits_dactuacio/empresa_i_produccio_sostenible/economia_verda/impuls_economia_verda/index.html -	2015 Upcoming 2022 (3Q or 4Q)
Prague	Circular Prague 2030	https://portalzp.praha.eu/jnp/cz/odpady/pr edchazeni_vzniku_odpadu/strategie_HMP_pro_prechod_na_cirkul_ekonomiku_2030.html	2022

Madeira	Circular Madeira 2030	https://madeiracircular.pt/regulamentacao	2021
Brussels Capital Region	Brussels Regional Program for a Circular Economy 2016 – 2020 (BRPCE)	https://www.circulareconomy.brussels/a-propos/le-prec/?lang=en	2016
Region of Central Macedonia	Action Plan for promotion of the circular economy in SMEs of the Region of Central Macedonia	https://projects2014-2020.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1544096220.pdf	2018
Galicia	Galician Circular Economy Strategy 2020-2030	https://sirga.xunta.gal/c/document_library/get_file?folderId=190428&name=DLFE-55795.pdf	2019
Capital Region (Lithuania)	-	No link was provided by the expert	-
Emilia-Romagna Region	1.Circular Economy Regional Law n.16/2015	https://ambiente.regione.emilia-romagna.it/it/rifiuti/temi/rifiuti/economia-circolare	2015
	2.Update of the Regional Law n.16/2015	-	Upcoming 2022
South Holland	Strategy Circular South Holland: Accelerate Together	https://circulair.zuid-holland.nl/	2019
Pays de la Loire	Regional Action Plan for the Circular Economy 2018-2025	https://www.paysdelaloire.fr/transition-ecologique/economie-circulaire	2019
East and North Finland	East and North Finland in industrial transition - smart specialisation strategy 2019-2023	https://elmoenf.eu/	2019
Flanders	Vision 2050: A Long-Term Strategy for Flanders	https://publicaties.vlaanderen.be/view-file/28831	2016
Upper Austria	#upperVISION2030	https://www.uppervision.at/en/the-programme	2020
Basque Country	Basque Country Circular Economy Strategy 2030	https://www.euskadi.eus/documentacion/2020/estrategia-de-economia-circular-de-euskadi-2030/web01-a2ingkut/es/	2020
Tuscany	Regional plan of the circular economy and remediation	https://www.regione.toscana.it/-/informazione-e-partecipazione-piano-economia-circolare-e-bonifiche	Upcoming 2022

Table 33: List of regional CE policies provided by the surveyed experts

The 24 experts which responded their region has a CE policy were asked for their opinion on the stage of the CE adoption (**Figure 45, Table 34**). According to the results of the survey, none

of the experts considered their region to have all objectives achieved. 6 experts from different regions, considered that their region has CE in place and it's functioning, while most of the experts, 11 in total, representing 9 regions, perceived to have the CE partly implemented in their region. Lastly, 7 experts from different regions believe the CE adoption in their region is still in development stage. Taking into consideration that this question was subjective and the experts were not provided explanation of the different answers, on some occasions different experts from the same region had different views regarding the stage of development of their region, in the context of the CE adoption. That was the case for Brussels Capital Region (1-In place, functioning, 2-In place, partly implemented), Luxembourg (1-In place, partly implemented, 1-In development) and South Holland (1-In place, partly implemented, 1-In development), which is presented also in **Table 34**.

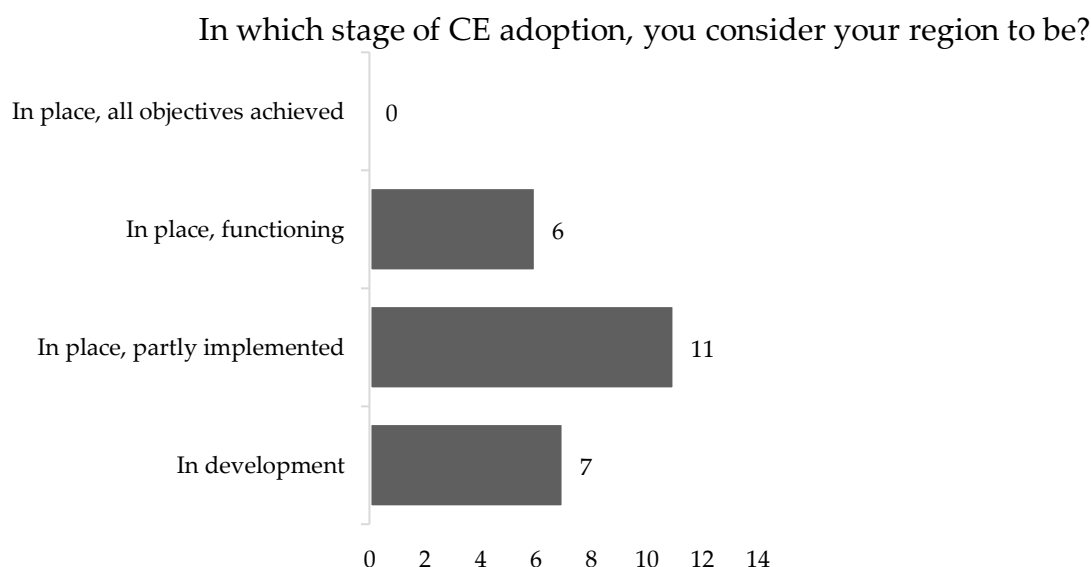


Figure 45: Share of surveyed experts regarding the various stages of regional CE adoption
(**Note:** Results based on a sample of 24 respondents that responded “Yes” to the question on the existence of CE policy)

Stage of CE adoption	Region	Country
In place, all objectives achieved	-	-
In place, functioning	Brussels Capital Region	Belgium
	Wallonia	Belgium
	Emilia-Romagna Region	Italy
	Pays de la Loire	France
	Flanders	Belgium
	Basque Country	Spain

In place, partly implemented	Luxembourg	Luxembourg
	Friesland	The Netherlands
	Catalonia	Spain
	Brussels Capital Region	Belgium
	Region of Central Macedonia	Greece
	Galicia	Spain
	Brussels Capital Region	Belgium
	South Holland	The Netherlands
	East and North Finland	Finland
	Catalonia	Spain
	Upper Austria	Austria
In development	Luxembourg	Luxembourg
	Central Jutland Regions (The Central Denmark Region)	Denmark
	Prague	Czech Republic
	Madeira	Portugal
	Capital Region	Lithuania
	South Holland	The Netherlands
	Tuscany	Italy

Table 34: Perceived stage of CE adoption in surveyed regions (**Note:** Results based on a sample of 24 respondents that responded “Yes” to the question on the existence of CE policy)

5.2.2 Section B: Smart Specialisation Strategies (S3)

The **section B** of the survey was dedicated to gather information regarding the S3 in the surveyed regions, the existence of CE as priority area, and ultimately unveil the links between the two concepts – S3 and regional CE policies. Hence, to begin with, the experts were asked to state whether their region has S3 and for which programming period (**Figure 46**). In total 25 experts, representing 23 regions (three experts from Region of Central Macedonia) stated their region has S3 for both programming periods. Five experts stated their region has S3 for the 2014-2020 programming period, representing following regions: Western Macedonia, Friesland, North Great Plain Region, Weser-Ems, and Eastern Macedonia and Thrace. Other five experts responded their region has developed S3 for the new programming period 2021-2027, representing Capital Region (Denmark), Stockholm, Western Slovakia, Pays de la Loire, and Upper Austria. One expert from Tuscany stated their region doesn’t have S3 for any of the programming periods. Finally, six experts chose the “Other”, out of which one didn’t provide explanation (Brussels Capital Region), one stated the strategy is part of the RIS 2017 (Luxembourg) and four didn’t know (Brussels Capital Region, South Holland, Catalonia, and Prague). Deviations in experts’ answers coming from same region were observed again, this

time in the case of Tuscany, Western Macedonia, and Upper Austria, as well as Brussels Capital Region, Luxembourg, Catalonia, and South Holland were some of experts didn't know the answer and chose "Other".

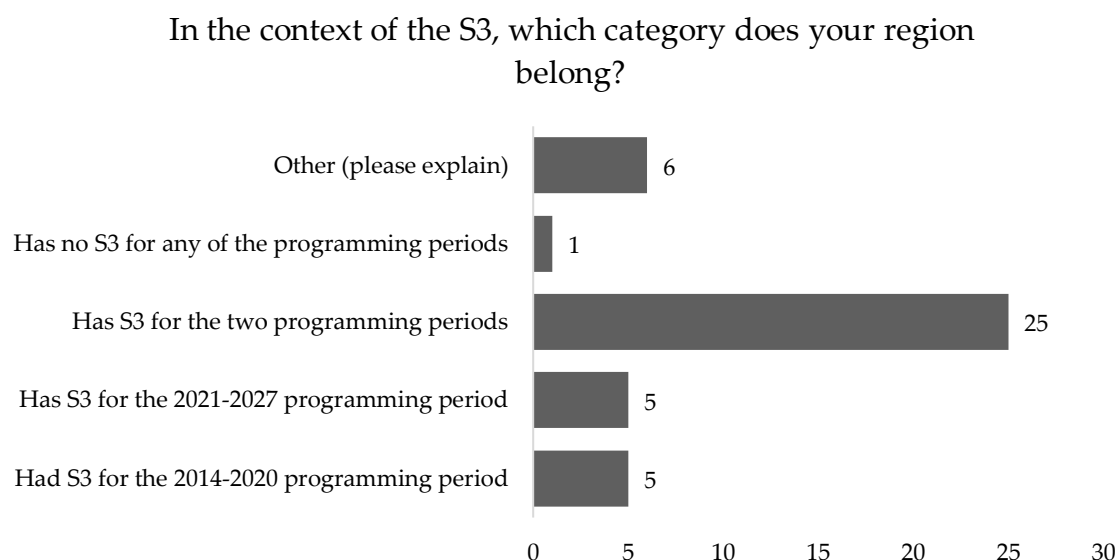


Figure 46: Share of surveyed experts regarding the existence of S3 in their respective regions

Figure 47 is illustrating the experts' responses about whether CE was selected as S3 priority in their region. According to the surveyed experts, the North Great Plain Region in Hungary was the only region which selected the CE as S3 priority for the 2014-2020 programming period. The majority of experts, 11 in total, stated the CE was indicated as S3 priority in the new programming period, including the regions of Western Slovakia, Upper Austria, Wallonia, Madeira, West Greece, Cyprus, South Holland, West Finland and the three experts from the Region of Central Macedonia. Ten experts claimed the CE was S3 regional priority for both programming periods in question. These experts represented 10 regions, among which Friesland, Western Macedonia, North-East Region, Brussels Capital Region, Galicia, Emilia-Romagna Region, East and North Finland, Catalonia, Upper Austria, and Tuscany. Likewise, 10 experts, representing 10 regions said CE was not selected as their regional S3 priority, including Western Macedonia, Weser-Ems, Eastern Macedonia and Thrace, Luxembourg, Malopolskie, Flanders, Capital Region (Lithuania), Stockholm, Basque Country, and Marche Region. However, the expert from Flanders clarified further in the survey that

the “CE is included as a horizontal focus in the roadmaps of the 10 priority domains in the Flemish S3”. Finally, three experts were not informed regarding, hence chose “I don’t know” (Pays de la Loire, Capital Region (Denmark) and Central Denmark Region). The experts from Upper Austria and Western Macedonia provided incompatible answers to this question.

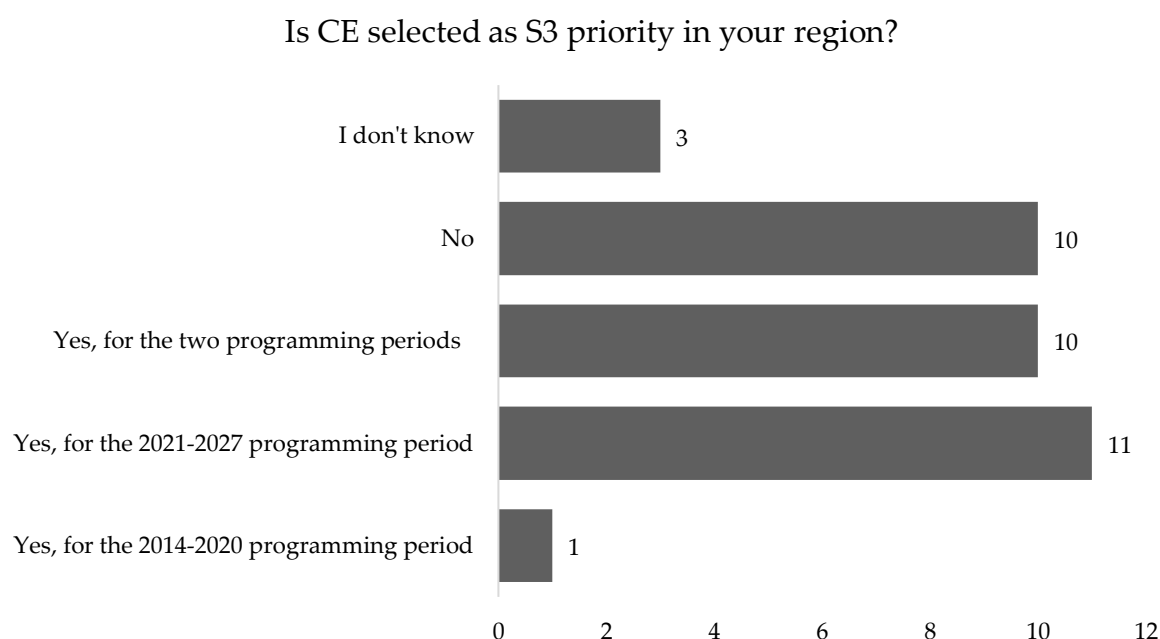


Figure 47: Share of surveyed experts regarding the selection of CE as S3 priority in their respective regions

In total, out of the 35 experts which stated their region has S3 in one or two programming periods, 22 experts representing 19 regions stated their region has selected CE as S3 priority in one or the two programming periods. Out of these 19 regions which have selected CE as priority in their S3, 12 have developed regional CE policies (see **Table 34**), hence a positive link can be observed between these two variables.

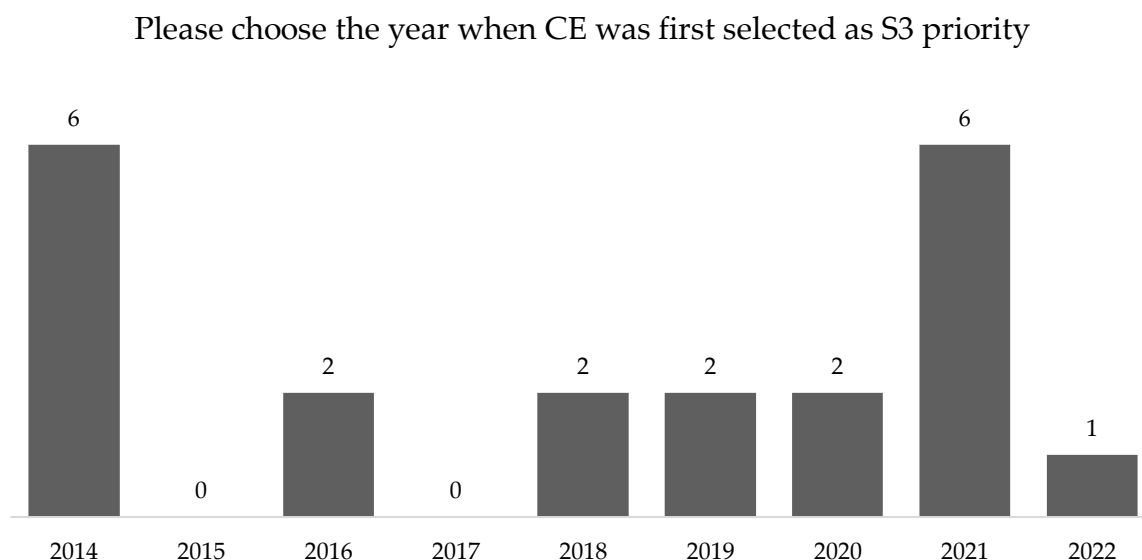


Figure 48: Share of surveyed experts regarding the first year of selection of CE as S3 priority in their respective regions

When asked for the first year when the CE was selected as S3 priority, it is notable that years 2014 and 2021 were selected as the most frequent answer (**Figure 48**). This is somewhat expected considering these two years are marking the beginning of the two programming periods of the S3. One expert from South Holland didn't provide answer to this question. From **Table 35**, which provides detailed breakdown per year, it is apparent that again deviation in answers can be observed, in the case of Upper Austria and the Region of Central Macedonia, where experts provided different answers to this question.

Year	Regions
2014	Western Macedonia, Brussels Capital Region, Galicia, North Great Plain Region, Catalonia, Tuscany
2016	North-East Region, Friesland
2018	Emilia-Romagna Region, Upper Austria
2019	East and North Finland, Upper Austria
2020	Madeira, Cyprus
2021	Wallonia, Region of Central Macedonia (x2), West Greece, Western Slovakia, West Finland
2022	Region of Central Macedonia

Table 35: Share of surveyed experts regarding the first year of selection of CE as S3 priority in their respective regions

With the purpose of gaining deeper contextual information, experts were asked to briefly state the reasons why CE was selected as S3 priority. Some of the experts reasoned the inclusion of CE as S3 priority within the overarching sustainability context, framing it as “one of the basic tools towards climate neutrality” (Western Macedonia), “confront effects of climate change” (West Greece), “to stimulate sustainable development within the region and to increase wellbeing” (Friesland), or CE is seen as “necessary element to foster sustainability and resilience” (Tuscany). Similarly, Catalonia considers CE a “transversal priority” and that “R&I has to contribute to a greener, more resilient and fairer socio-economic system”. The Brussels Capital Region has “identified circularity as one of the driving forces of its development strategy”, while the Region of Central Macedonia has included it as a “result of Entrepreneurial Discovery Process (EDP)”. Similarly, Wallonia has identified CE as priority, as a result of a process “starting from key societal challenges, identifying strengths and potentials of the region regarding RDI, industrial capacities, position in the value chain, cluster priorities and EU opportunities”. The North-East Region in Romania has “identified the regional value chains that meet societal challenges and their needs for integration and development has been assessed” sequentially. The Emilia-Romagna Region didn’t include CE formally in the 2014-2020 period, but in order to “redefine and broaden the driving forces of innovation in 2018 was formally included in the mid-term review as a cross topic of major interest, and further developed in the 2021-2027” programming period of the regional S3 documents”. In the case of Madeira, being an autonomous region of Portugal and island, the expert stated that CE is “considered a fundamental area for an insular outermost region like Madeira”.

Several experts articulated the inclusion of CE as their S3 priority in the light of their industrial structure, building up on their competitive advantage. This was the case of Upper Austria with the machinery, plastics and automotive industry, West Finland with the agri-food sector and South Holland with horticulture and agri-food sector. Western Slovakia is seeing the CE as “transition to smart industry and economy”, while East and North Finland points out to the new rapidly growing sector created by the utilisation of industrial side streams, like “developing methods for waste treatment and biomaterials”. Last but not least, in the case of Cyprus, it was a mix of reasons for the inclusion of CE as priority in their S3, starting from the “increasing the EU’s level of climate ambition for 2030 and 2050” until specific benefits for

each industry emerging from the adoption of CE practices, like “construction and renovation of buildings in an efficient way in terms of energy consumption and resources, accelerate the transition to sustainable and smart mobility and design of a fair, healthy and environmentally friendly food system”.

What do you think is the direction of influence between S3 and regional CE policies?

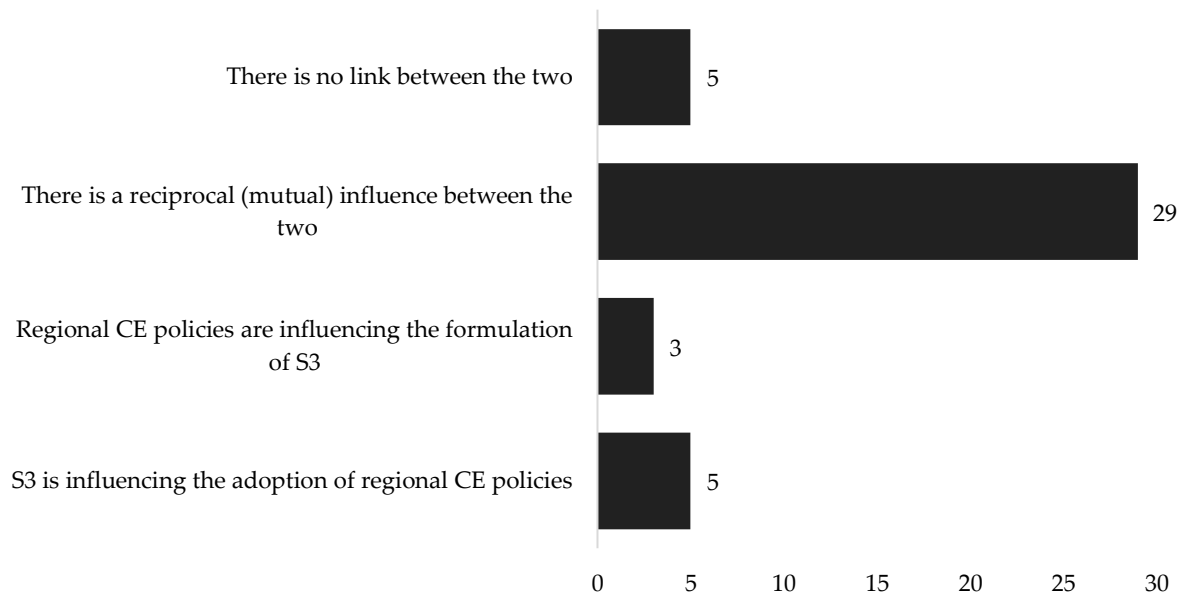


Figure 49: Share of surveyed experts regarding the direction of influence between S3 and regional CE policies

In order to explore the relationship between the S3 and regional CE policies, the experts were asked their opinion regarding the direction of influence between these two concepts (**Figure 49**). The vast majority of the experts (69%) considered there is a mutual influence between the two, while 7% thought regional CE policies are influencing the formulation of S3, and 12% believed S3 is influencing the adoption of regional CE policies. The remaining 12% expressed their opinion that there is no link between the two concepts, and these experts were representing the following regions: Central Denmark Region, North-East Region, Western Macedonia, Prague, and South Holland.

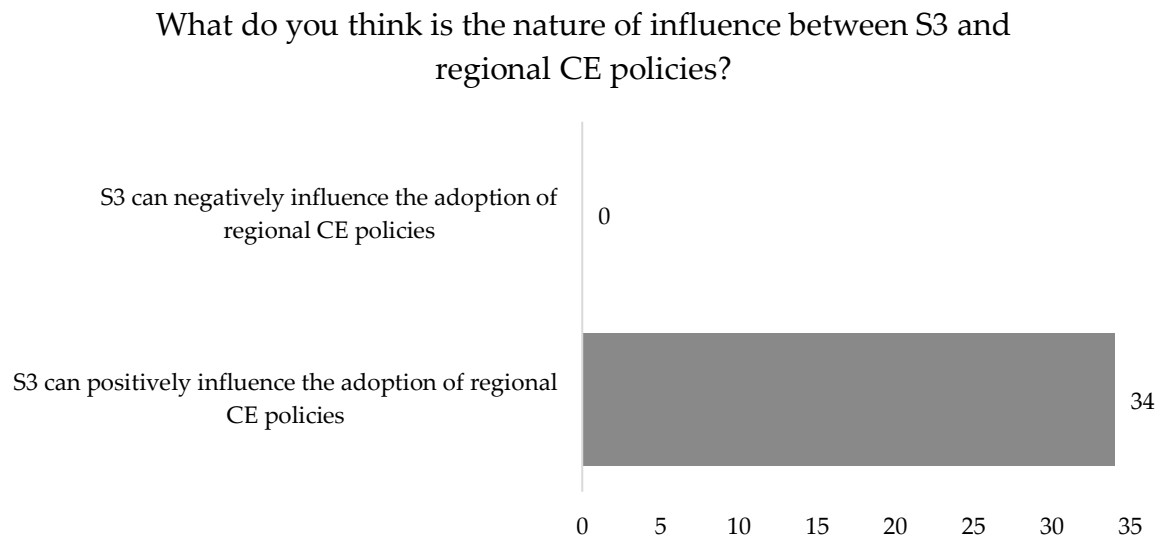


Figure 50: Share of surveyed experts regarding the nature of influence between S3 and regional CE policies

In addition, the experts were asked regarding the nature of influence between S3 and regional CE policies (**Figure 50**). All of the experts responded that S3 can positively influence the adoption of regional CE policies (check **Figure 49** - 29 experts which believed in the mutual relation between the concepts, plus 5 experts which believed S3 is influencing the adoption of regional CE policies, hence, 34 experts in total). This unanimous opinion regarding the positive influence, and the fact that not even one expert considered S3 can have some sort of negative effect on the adoption of the regional CE policies was unanticipated and will be additionally explored in the following stages of the policy Delphi study.

Similarly, when asked regarding the nature of influence between regional CE policies and S3, all experts shared an undivided opinion that regional CE policies can positively influence the formulation of S3 (**Figure 51**). The total number of 32 experts comes from the 29 experts which believed in the mutual relation between the concepts, plus 3 experts which believed regional CE policies are influencing S3 (**Figure 49**). Likewise, the previous results, this is one of the main areas of interest which will be more deeply explored during the semi-structured individual interviews.

What do you think is the nature of influence between regional CE policies and S3?

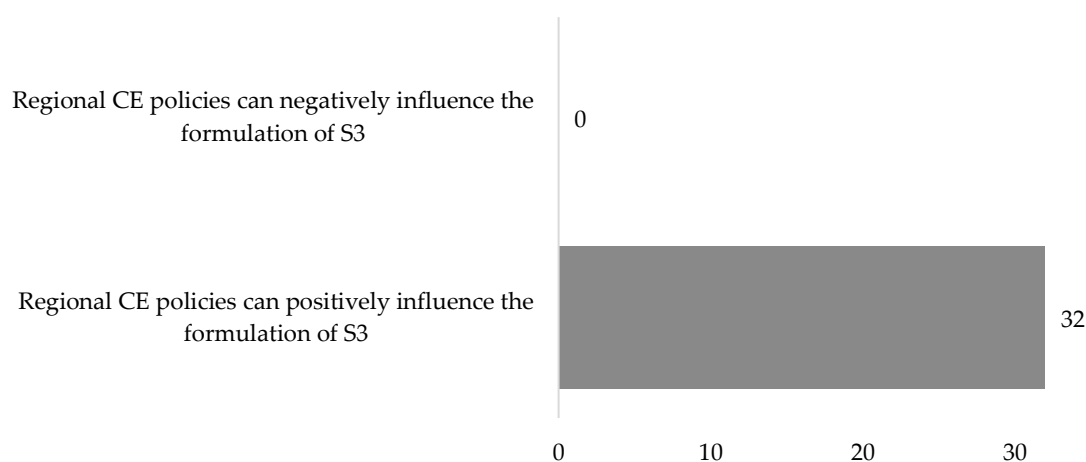


Figure 51: Share of surveyed experts regarding the nature of influence between regional CE policies and S3

5.2.3 Section C: Measuring progress towards Circular Economy (CE)

Section C was aiming to obtain an initial idea of the measurement efforts towards the CE adoption in the surveyed regions (**Figure 52**). It is apparent that the majority of the regions are still in the process of planning and developing specific regional CE indicators (22 experts representing 19 regions). However, many were the regions which are using existing CE indicators from other levels, like the European level (the EU CE monitoring framework – 15 experts representing 12 regions) and the national level (10 experts representing 10 regions); or not specific CE indicators but closely related regional indicators as proxy (10 experts representing 9 regions).

In total 10 experts representing 9 regions (since two experts were from the South Holland region) stated their region has developed specific CE regional indicators for monitoring the adoption of the CE practices. These regions were Basque Country, Brussels Capital Region, Catalonia, Galicia, Flanders, Emilia-Romagna Region, South Holland, North Great Plain Region, and Upper Austria. All of these regions have already devised a regional CE policy, except the North Great Plain Region (Hungary). Hence, a positive relationship might be observed between the existence of a regional CE policy and measuring efforts towards regional circularity. The Flanders region appears to be one of the front-runners not only in the

context of measuring regional circularity but also in the online availability of information and transparency. The Monitor Circular Economy Flanders website (<https://cemonitor.be/over/over-deze-monitor/>) provides quite an extensive information regarding the Flemish monitoring framework. The Circular Economy Support Centre in collaboration with other public institutions, has built a three-layer framework with over 100 indicators, measuring the circularity of the Flemish economy (for 2018 Flanders was 21% circular). Overall, the importance of comparing the indicators used by different EU regions to measure progress towards circularity was particularly highlighted by one policy expert from the Brussels Capital Region.

Nine experts stated they are not measuring the progress towards the CE in their respective region. The experts from Weser-Ems and West Finland regions have stated they don't measure the progress towards the CE, which could be explained by the fact that in Germany and Finland, respectively, the NUTS 2 regions are not having the legislative and administrative power like in Italy or Spain for example. Malopolskie, Marche Region and Western Macedonia are also not measuring the progress towards CE currently, though the policy experts stated they are in the process of planning/developing specific regional CE indicators. Eastern Macedonia and Thrace region is also not measuring the regional circularity, but instead they are using other related regional indicators as proxy, while Cyprus is not currently measuring circularity, it is in the process of planning/developing specific regional CE indicators but meanwhile is using the indicators from the EU CE monitoring framework. The representatives of Catalonia and Upper Austria have provided multiple answers to this particular question. These two regions were actually the only ones that have developed regional CE policies, the remaining seven do not have yet. Finally, it is worth noting that on some occasions different experts representing the same region have selected different responses to this question, raising some concerns regarding their awareness, aligned views regarding the topic and how well-informed they are. These regions were Upper Austria, Brussels Capital Region, Region of Central Macedonia, West Macedonia, Luxemburg, Catalonia, and South Holland.

Which of the following is true for your region? (multiple answers possible)

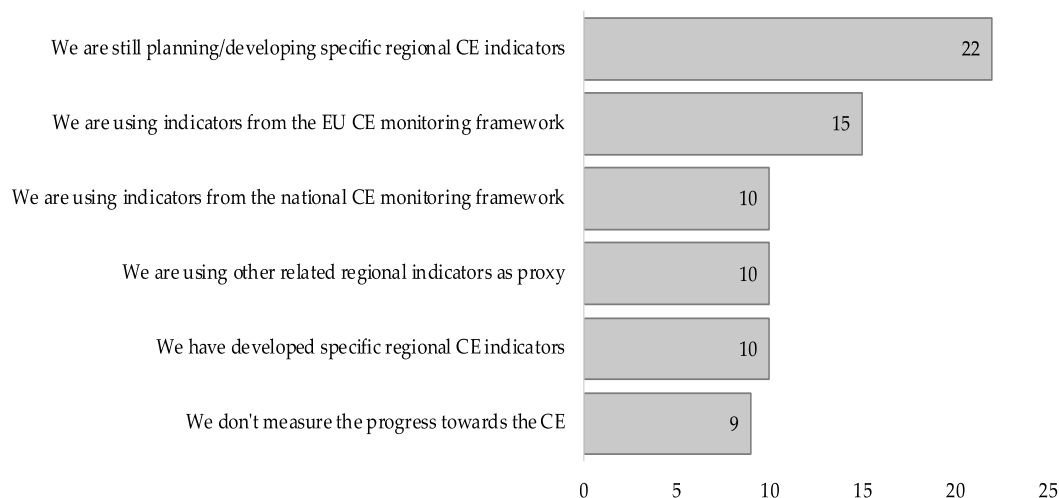


Figure 52: Share of surveyed regions' measurement efforts towards CE (**Note:** Multiple answers were possible to be selected)

5.2.4 Section D: Institutional pressures influencing regional Circular Economy (CE) policies

The last section of the survey, **section D**, was intending to unveil the institutional pressures which influenced the adoption of CE policies in the surveyed regions. For that purpose, the Likert scale with 5 points was used, allowing the surveyed policy experts to express to what extent, according to their subjective opinion, different pressures have driven or inspired the adoption of CE policies in their respective regions. In order to quantify the results, numerical values were added to the five provided answers, "Not at all" being "1" and "Fully" being "5". The results are presented in **Table 36**.

Institutional Pressure/Likert Scale	Not at all (1)	Slightly (2)	To some extent (3)	To a very high extent (4)	Fully (5)	Weighted Average
1. To what extent was/is the adoption of CE policies in your region driven by pertinent international/EU legislation? (C1)	4 10%	4 10%	16 38%	16 38%	2 5%	3,19
2. To what extent was/is the adoption of CE policies in your region driven by pertinent national legislation? (C2)	6 14%	8 19%	17 40%	9 21%	2 5%	2,83
3. To what extent was/is the adoption of CE policies in your region driven by pertinent regional legislation? (C3)	12 29%	6 14%	13 31%	4 10%	7 17%	2,71
4. To what extent was/is the adoption of CE policies in your region driven by the interaction with other regional stakeholders (from industry, government, academia, society)? (N1)	4 10%	4 10%	15 36%	15 36%	4 10%	3,26
5. To what extent was/is the adoption of CE policies in your region driven by international/European/national/regional associations, networks, organisations, advisory bodies? (N2)	7 17%	9 21%	17 40%	7 17%	2 5%	2,71
6. To what extent was/is the adoption of CE policies in your region driven by awards, certifications, and available EU funding programmes in the area of CE? (N3)	5 12%	16 38%	8 19%	13 31%	0 0%	2,69
7. To what extent was/is the adoption of CE policies in your region inspired by other similar regions (in terms of population/ GDP/ development stage etc.)? (M1)	7 17%	17 40%	15 36%	3 7%	0 0%	2,33
8. To what extent was/is the adoption of CE policies in your region inspired by neighbouring regions? (M2)	13 31%	15 36%	11 26%	3 7%	0 0%	2,10
9. To what extent was/is the adoption of CE policies in your region inspired by other leading regions in the CE area? (M3)	5 12%	16 38%	14 33%	7 17%	0 0%	2,55

Table 36: Influence of institutional pressures (coercive, normative, and mimetic) on the adoption of CE policies in the surveyed regions

The nine different pressures, belonging to coercive, normative, and mimetic respectively, were developed in **section 4.4.2 (Table 30)**. The first three statements were corresponding to coercive pressures (C1, C2 and C3), statements 4 to 6 were related to normative pressures (N1, N2 and N3) and the last three statements were mimetic pressures (M1, M2 and M3). **Table 36** shows the number of experts which selected an answer (from 1 to 5) for each statement (institutional pressure), also express as percentage (%) for better comprehension and analysis. As already mentioned, several regions had more than one expert, and since this question is subjective, different experts from same region provided different opinion. With the purpose of obtaining additional information, the weighted average per pressure was calculated, used afterwards for developing the regional matrix illustrated in **Table 37 and 38**.

There seems to be no predominant driver in terms of institutional pressures which are explaining the adoption of CE policies at the regional level. The “international and EU legislation” (C1) appears as the most dominant pressure from the coercive ones, and the “interaction with other regional stakeholder” (N1) emerges as the most prominent one from the normative pressures and overall, from all listed pressures. These two pressures are the only ones that score on average above 3, C1 scoring 3,19 and N1 scoring 3,26. The mimetic pressures M1 and M2 seems to have the lowest role in the interpretation of the results. Even though the difference is not very high, the results are suggesting that N1 and C1 respectively, are the most relevant institutional drivers for the adoption of CE policies in the European regional context, according to the surveyed experts. This could be preliminary interpreted as a two-way mechanism, pressures directed from the top (C1) and pressures emerging within the region, arising from the interaction and mobilisation of other regional stakeholders from the Quadruple Helix model, except the government, coming from the academia, industry, society (N1).

Figure 53 is showing the answers of the surveyed experts regarding the coercive pressures and the extent of their influence on the adoption of CE policies in their regions. It is apparent that the majority of regional CE policies were adopted as a result of the pertinent international and EU legislation in the area of CE (C1), like the EU CE Action Plan, the EU Green Deal, and the direct top-down pressure they exerted in the regional context. The related national legislation in the EU Member States (C2), like National CE Action Plan, Strategies or Agendas, were perceived as less influential, leaving the relevant regional legislation (C3), e.g., regional

directives and laws in the sustainability area, or other regional sustainability/environmental agendas as being the least influential coercive pressure according to the examined experts.

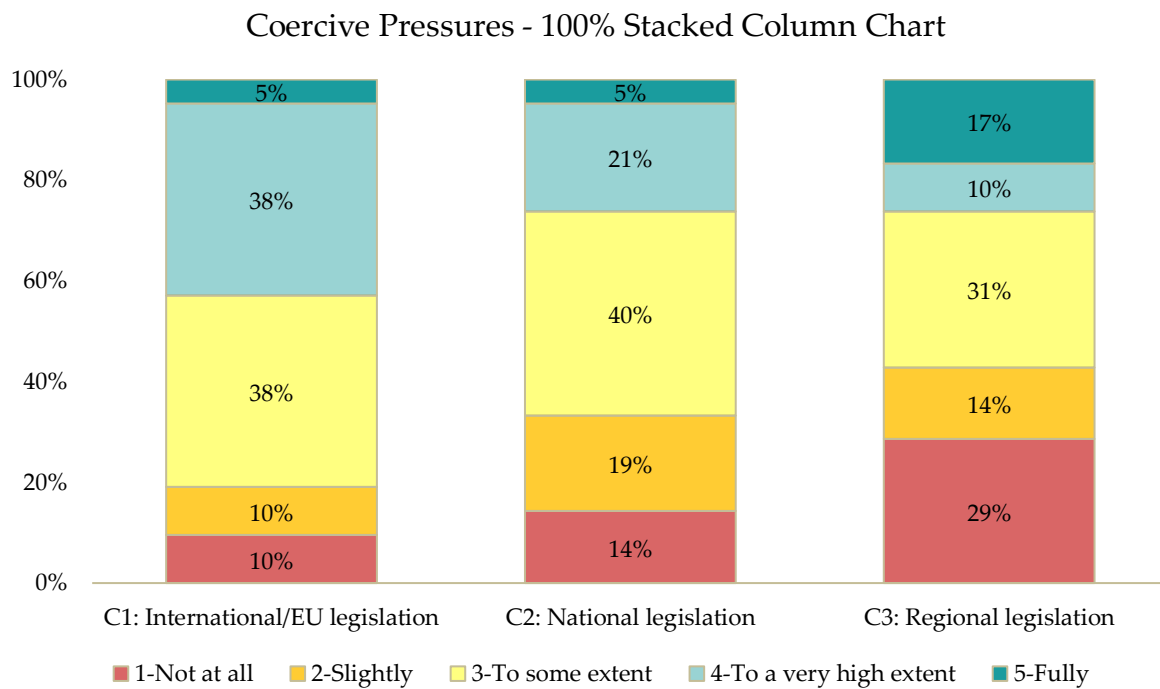


Figure 53: Influence of coercive pressures on the adoption of CE policies in the surveyed regions

The normative pressures and their influence are illustrated in **Figure 54**. The interaction with regional stakeholders (N1) is obviously the predominant driver overall, which fostered regions to implement CE policies. The associations, networks, organisations, and advisory bodies on different levels, in the area of CE (N2) as well as the awards, certifications and EU funding programmes in the CE area (N3) were perceived as having approximately the same influence on the implementation of CE policies. In the context of the normative pressures, more specifically N2, one expert of South Holland region expressed his opinion for the importance of N2 as *“the networks where EU regions work together and influence each other positively. From this collaboration and influencing, common points of view arise that you can offer to the EC with a lobby and position paper. This creates bottom-up policy development from the regions that has already been embraced. Instead of finger pointing from above as EC”*.

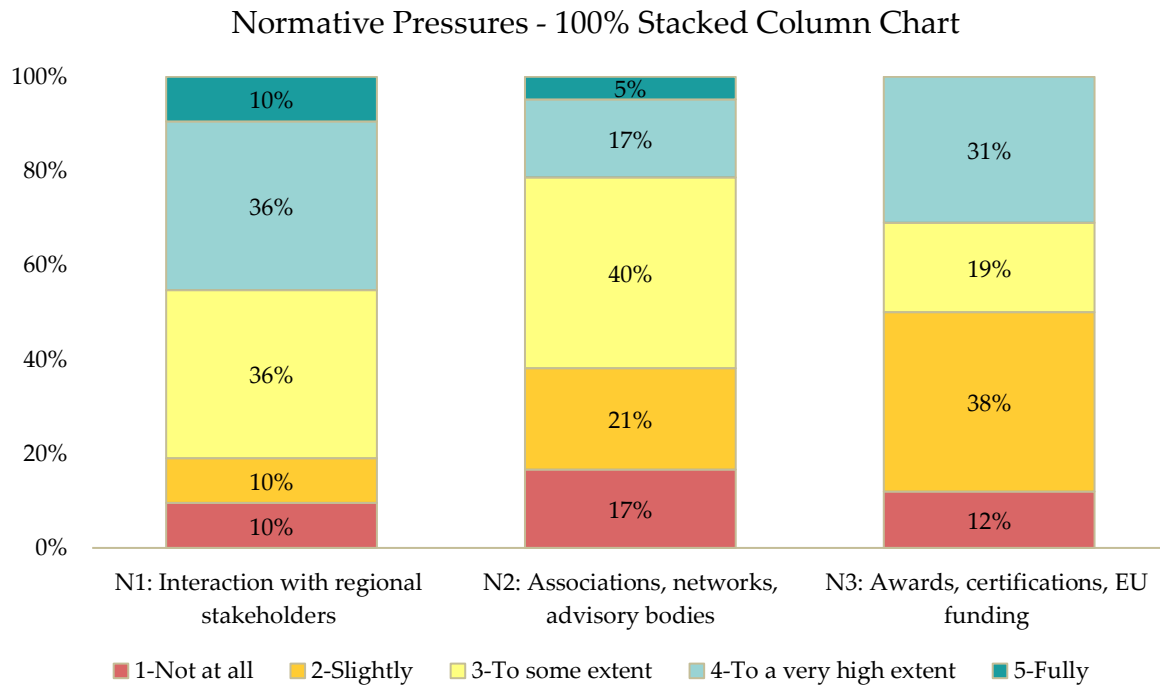


Figure 54: Influence of normative pressures on the adoption of CE policies in the surveyed regions

The mimetic pressures were considered as the least influential ones (**Figure 55**). It seems that regions were mostly inspired by other regions which transpired as leaders in the CE transition with their pioneering actions and projects (M3). Regions were inspired by a lesser extent by similar regions in term of population, GDP, development stage (M1), and finally, the actions of neighbouring regions and geographic proximity (M2) didn't seem to affect the actions of the surveyed regions in the development of their regional CE trajectory. At the same time, M2 was deemed as the least instrumental driver overall, from all three groups of institutional pressures.

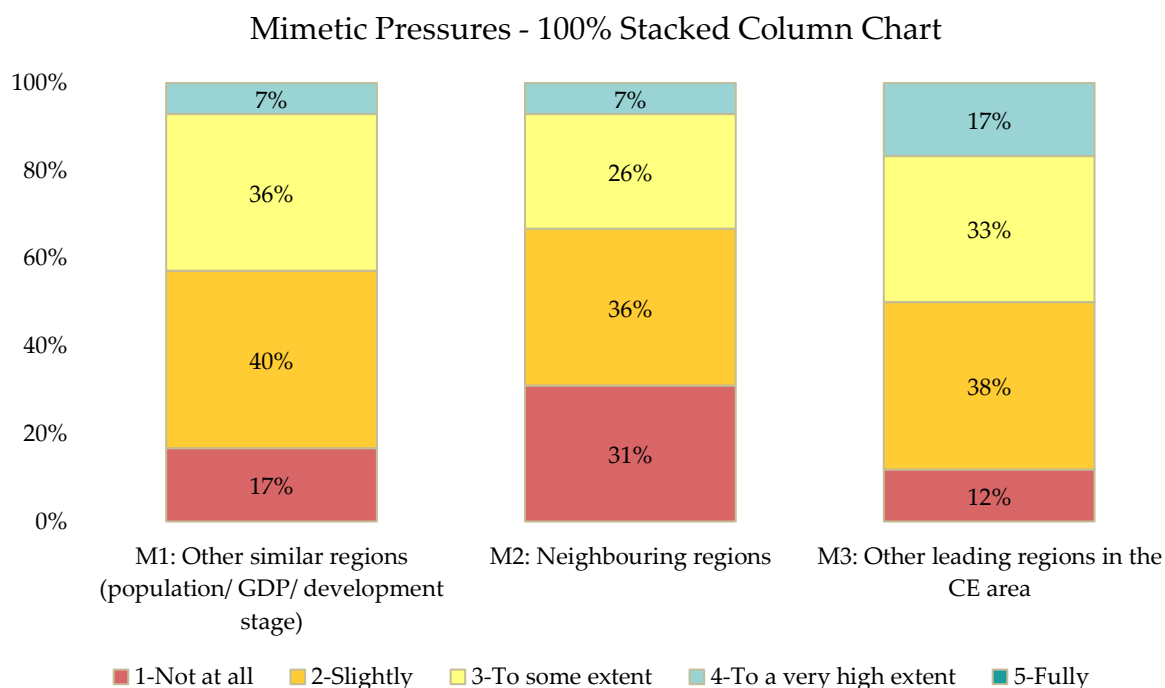


Figure 55: Influence of mimetic pressures on the adoption of CE policies in the surveyed regions

Overall, the findings related to institutional pressures seem to suggest that there is no predominant pressure which has a very strong influence in the adoption of regional CE policies. Additionally, the most relevant pressures appear to be the ones which are internal to the region. The prevalent driver emerges from within the region, arising from the interaction with the Quadruple helix actors in the regional context (N1), implying a bottom-up approach. The subsequent most influential pressure is the international and EU legislation (C1), exercising a top-down power on the regions to align their actions to the international and EU agendas. This can be interpreted as a two-way mechanism, a balanced approach for implementing a CE policy within the EU regions. Hence, there is a strong argument for having a very place-based policies for the transition towards the CE. It is not sufficient to promote a white paper at the EU level or a directive; the way to go forwards seems to be to identify the strengths of each region, industrial sectors, interact and mobilise relevant regional stakeholders, identify what's needed to close the loop and proceed with targeted investments. This seems to be the emerging trajectory for the regional CE transition which proves to be working in the European NUTS 2 regions.

The weighted average per pressure, calculated in **Table 36**, was further used to map the CE institutional pressures in the surveyed regions (**Table 38**). Namely, the answer provided by each policy expert regarding the influence of each pressure in their own region was compared to the average for each pressure and accordingly mapped in the regional matrix. Considering that some regions were represented by more than one policy expert, those regions can be found multiple times in the matrix. All pressures were having an average of 3, except M1 and M2 which had an average of 2. Hence, with green were represented regions ranking higher than the average, orange was the colour used for the average scorers and red for the regions scoring below the average. Overall, the majority of the regions were performing around the calculated average (131), followed by below the average scoring (126) and finally above average (121), presented in **Table 37**. Furthermore, regions seem to be performing the highest in the normative pressure N1, “interaction with regional stakeholders” (19), followed by coercive pressure C1, “international/EU legislation” (18) and mimetic pressure M1, “other similar regions in terms of population, GDP, development stage” (18). In terms of scoring below average, the most dominant ones are normative pressure N3, “awards, certifications, EU funding programmes” and mimetic pressure M3, “other leading regions in the CE area”, where 21 regions scored below the average, followed by the coercive pressure C3, “regional legislation” where 18 regions scored below average.

C1	C2	C3	N1	N2	N3	M1	M2	M3	Total
18	11	11	19	10	13	18	14	7	121
16	17	13	15	16	8	17	15	14	131
8	14	18	8	16	21	7	13	21	126

Table 37: Total score of regional performance per institutional pressure in the surveyed regions (**Legend:** green = above average; orange =average; red = below average)

Region/Institutional Pressure	C1: International/EU legislation	C2: National legislation	C3: Regional legislation	N1: Interaction with regional stakeholders	N2: Associations, networks, advisory bodies	N3: Awards, certifications, EU funding	M1: Other similar regions (population/ GDP/ development)	M2: Neighbouring regions	M3: Other leading regions in the CE area
Luxembourg	3	4	3	1	2	2	1	2	2
Capital Region (Denmark)	3	3	3	4	3	4	3	4	3
Luxembourg	4	3	2	4	2	2	1	2	2
Western Macedonia	4	3	3	3	5	4	3	3	3
North-East Region	1	1	1	1	1	1	1	1	1
Western Macedonia	4	5	1	4	3	3	3	1	2
Malopolskie	4	3	4	2	4	4	4	3	4
Brussels Capital Region	4	4	3	4	4	4	3	4	4
Friesland	3	3	4	5	3	2	2	1	2
Stockholm	1	1	1	3	3	3	1	2	3
Central Denmark Region	3	3	3	3	2	2	2	1	2
Wallonia	3	2	3	4	3	1	3	3	3
Catalonia	3	2	5	4	3	4	3	2	4
Prague	4	3	2	3	3	2	2	2	2
Madeira	5	1	3	5	4	4	1	1	1
Region of Central Macedonia	3	4	1	3	3	3	3	3	3
Brussels Capital Region	5	3	3	3	3	2	3	2	3
West Greece	3	3	2	3	2	2	3	1	2
Region of Central Macedonia	3	2	1	4	4	4	4	2	4
Region of Central Macedonia	4	4	1	3	4	4	4	1	4
Cyprus	4	2	2	4	3	4	2	1	3
Galicia	4	3	3	4	1	2	2	2	2
Brussels Capital Region	4	3	3	4	5	4	2	1	3
Capital Region (Lithuania)	4	3	1	2	4	4	3	3	4
North Great Plain Region	3	3	2	3	3	2	3	2	2
Western Slovakia	4	5	4	4	3	4	3	3	3
Emilia-Romagna Region	2	2	5	3	1	3	3	1	3
South Holland	2	2	5	4	4	3	2	4	4
Weser-Ems	1	1	1	1	1	1	1	1	1
Pays de la Loire	2	4	1	2	1	1	1	2	1
East and North Finland	3	4	3	3	2	2	2	3	2
Flanders	3	1	5	4	1	2	2	2	2
Catalonia	4	3	4	3	3	3	2	2	3
Upper Austria	3	3	5	5	3	3	3	3	3
Upper Austria	4	3	1	5	3	4	3	2	3
Eastern Macedonia and Thrace	1	1	1	1	1	2	2	1	2
Basque Country	4	2	5	4	3	1	2	1	2
Tuscany	2	2	2	2	2	2	2	2	2
Marche Region	3	3	3	3	2	2	2	3	2
South Holland	3	4	3	4	2	2	2	3	3
West Finland	3	4	1	3	2	3	2	3	1
Tuscany	4	4	5	3	3	2	2	2	2

Table 38: Mapping of CE institutional pressures in surveyed regions *Legend: green = above average; orange =average; red = below average)*

In terms of the individual regional performance, from **Table 38** can be observed that Brussels Capital Region is scoring the highest, performing in eight out of the nine pressures above average, and in one pressure, C3, on average. Certainly, this was according to the view of one of the three experts representing the region, the other two experts didn't have so optimistic opinion regarding the regions' performance. Western Slovakia followed, with seven pressures scoring above average, and only two at average, N2 and M3. Malopolskie region was on the third place, with seven pressures ranking above average, C2 on average and N1 below average. On the other hand, the lowest ranking regions were the North-East Region and Weser-Ems region, scoring below average on all nine institutional pressures. Eastern Macedonia and Thrace followed, scoring below average on eight pressures, and on average on M1. Tuscany was next with seven pressures below average and M1 and M2 on average, and finally, Pays de la Loire with seven pressures below average, M2 on average and C2 above average.

5.2.5 Emerging findings from the survey

Several emerging findings can be highlighted from the survey results, which will be further explored in the following stages of the policy Delphi study. Deviations in responses between different experts coming from the same region were observed throughout the whole survey.

19 out of the 32 surveyed regions have already developed a regional CE policy, in the form of a strategy, action plan, roadmap or regional law. In total, out of the 35 experts which stated their region has S3 in one or two programming periods, 22 experts representing 19 regions stated their region has selected CE as S3 priority in one or the two programming periods. Out of these 19 regions which have selected CE as priority in their S3, 12 have developed regional CE policies (see **Table 33**), hence a positive link can be observed between these two variables. In terms of the direction of influence between the S3 and regional CE policies, the vast majority of experts (69%) considered there is a mutual influence between the two concepts. More interestingly, when asked about the nature of influence between the S3 and regional CE policies, and vice versa, all experts considered it as a positive influence.

When it comes to the measurement efforts towards the CE adoption in the surveyed regions, the majority of the regions are still in the process of planning and developing specific regional

CE indicators (22 experts representing 19 regions). However, many were the regions which are using existing CE indicators from other levels, like the European level (the EU CE monitoring framework – 15 experts representing 12 regions) and the national level (10 experts representing 10 regions); or not specific CE indicators but closely related regional indicators as proxy (10 experts representing 9 regions). In total only nine regions have developed specific CE regional indicators for monitoring the adoption of the CE practices, and eight of them have already devised a regional CE policy, implying a potential positive relationship between the existence of a regional CE policy, and measuring efforts towards regional circularity.

Last but not least, the results related to the institutional pressures revealed interesting findings. There seems to be no predominant driver in terms of institutional pressures which are explaining the adoption of CE policies at the regional level. The “international and EU legislation” (C1) appears as the most dominant pressure from the coercive ones, and the “interaction with other regional stakeholder” (N1) emerges as the most prominent one from the normative pressures and overall, from all listed pressures. This could be preliminary interpreted as a two-way mechanism, pressures directed from the top (C1) and pressures emerging within the region, arising from the interaction and mobilisation of other regional stakeholders from the Quadruple Helix model, except the government, coming from the academia, industry, society (N1). The mimetic pressures M1 and M2 seems to have the lowest role in the interpretation of the results. When mapped against the average per each pressure, the majority of regions seem to be performing on average. Top performers, based on the answers of the experts were Brussels Capital Region, followed by Western Slovakia and Malopolskie region, while on the bottom of the list were North-East Region, Weser-Ems, followed by Eastern Macedonia and Thrace.

As already mentioned, these results which arise from the survey, will be in depth explored in the upcoming stages of the policy Delphi methods, the individual interviews, and the Policy Brief validation.

5.3 Individual interviews – analysis and discussion of results

The semi-structured interviews were around five main topics, as already explained extensively in **section 4.7.3**, and presented in the Interview Protocol available in **Appendix E**. The transcribed 19 interviews, included in **Appendix G** were then coded using TA as elaborated in **section 4.7.4** and **4.7.4.1** where the final template V5 was developed (**Appendix H**) comprised of ten main themes. All top themes are listed in **Table 39** along with their colour code and analysed in detail in the following sections (**section 5.3.1** to **5.3.10**).

Main Themes from final Template V5	Colour Code/ Section
I. The regional narrative in the CE transition	Section 5.3.1
II. Division of power as common denominator for EU regions	Section 5.3.2
III. Multi-level governance mechanisms	Section 5.3.3
IV. Formulation & implementation of developmental strategies	Section 5.3.4
V. Architecture of regional CE policies	Section 5.3.5
VI. S3 & CE nexus: influences, risks & mitigation mechanisms	Section 5.3.6
VII. EU Green Deal & CE policies: formulation, implementation & main challenges	Section 5.3.7
VIII. Institutional pressures driving the adoption of regional CE policies	Section 5.3.8
IX. The vital role of CE hubs (networks) in the transition	Section 5.3.9
X. Regional frameworks for measuring and monitoring CE progress	Section 5.3.10

Table 39: Main themes from final Template V5 with colour code and related sections

5.3.1 The regional narrative in the CE transition

This theme focused on presenting the regional narrative for the CE transition, divided in two major sub-themes. The first one was related to all the aspects and determinants which are defining each region and consequently the regional trajectory it will have towards the CE, as put forward in *I11* – “every region...has its own specifications and its own circumstances that they have to accept”. The second one encompassed the role and importance of regions in the CE transition, looking at the term region from two perspectives: as level of implementation and as regional authority.

Within the regional identity forming aspects sub-theme, the chronological arrangements were considered initially, splitting the determinants into former, incumbent, and prospective according to the time period. The factors which could influence the regional transition towards the CE were categorised into: 1) different regional barriers and challenges regions are

facing (e.g. I18 – “there’s a number of European regions whose economies depend to a great extent on coal extraction and use.”), 2) regional strengths and competitive advantages which are in the centre of the S3 place-based optic (e.g. I7 – “...in Śląskie region there’s a lot of industry, there is not so much agriculture, so we cannot expect that they will proceed with the agriculture goals in the industrial region. So, that’s more in the Lubelskie region for example...”) and 3) regional opportunities that each region can leverage on (e.g., I15 – “there are so many opportunities at least on the regional level in Greece for the circular economy...and all of them can be implemented without the massive cost and have a strong impact on the local economy - which means that actually there is space for improvement...”). Lastly, the regional dynamics characterised by different idiosyncratic factors are taken into account, including 1) geographical factors, 2) economic factors, 3) social factors, 4) environmental factors, 5) political factors (e.g. I11 – “in Slovakia now, there is not good political situation, because we have a minority government, and these topics are not in a high tension now.”), 6) cultural factors and 7) technological factors. The industrial structure of the region also proved to be vital for the territorially differentiated transition of each region, particularly in the regions with *Natural resource-based industries* (NRBIs). The case of Slovakia is one such example, that used to be “strongly industrialised country...had many iron works, and steel works, and aluminium works,” and now it has “many remnants from the past” because all “companies and these fabrics left several dangerous loads and land fields, and similar areas which today are a big risk for the health of the inhabitants that live in the neighbourhood of these areas... and circular economy is one way to deal with these issues.” (I11).

The role and importance of regions in the CE transition is the second sub-theme, where initially the varying importance of regions within EU is acknowledged, which depends on the degree of the political authority the region has, the amount and type of financial resources it can mobilise and the existing regional capacities to govern available instruments and influence stakeholders’ actions. In the context of the financials resources a discrepancy is observed between developed and lagging behind regions, as stated in I18 - “an important cleavage there is between regions that benefit from the ERDF and which depend mostly or entirely on the ERDF for the circular economy initiatives; and regions which have their own resources, typically in more developed Member States such as France, Germany, Austria and the Nordic states”. The role and importance of regions was overall recognised in all discussions throughout the interviewing phase, and it was perceived through two different optics – as territorial level of

implementation and as regional authority. Regions are perceived as optimal scale fit for structural purposes, because *“a municipality is too small, national is sometimes too big”* and *“things don’t really happen on a national level, things happen locally”* (I13). Additionally, looking at the transition from a value-chain perspective the *“local level often hits the limitations of the local territory”* (I14) and *“the regional scale is the most appropriate in order to minimise the logistics and the use of resources”* (I1). One participant expressed the view that the collection of natural resources is far more relevant on municipal level and should take place locally, but the exploitation of the collected materials should happen on regionally. In some instances, like in Slovakia, the highly fragmented territorial division was highlighted and the related challenges arising from coordinating the large number of municipalities. Additionally, the alarming issue of creating regional bottlenecks was raised, whereby large set of top-down policies that have very sectorial approach of application are ending at the regional level and *“frankly nobody knows whether these rules support each other, work against each other, have positive effects or negative effects”* (I16). In this respect the scale of consideration was indicated as important, with the chance to adjust the scale where needed.

As regional authorities, regions are having many different roles in the CE transition, including implementing CE activities like public procurement, waste management, promotion of CE, but also providing the legislative framework using *“regulation in order to eliminate barriers, in order to eliminate inconsistencies between different regulations and policies”* (I1). Regional governments can also provide economic incentives and disincentives, allocate and manage relevant EU funds, coordinate lower territorial units, convey EU policies and initiatives to local territories and monitor and measure the progress towards the CE. Regions are essentially catalysers between national and municipal level, combining the strategic level and the practical eye. This is clearly outlined in I14 – *“regions are in this, very optimal position that they can liaise upwards to their national member states but also downwards to the municipalities and the cities in their region”* and I13 – *“it’s because we can translate the more strategic and top-down things that happen on national and European level and combine them with the often bottom-up things that happen on a municipal level and translate those two towards each other”*. Nevertheless, the national level remains to be very important, especially in terms of legislation and funding, therefore the interplay between all governance levels should be maximised. Considering the systemic changes embedded in the CE concept, *“an ecosystem approach is key to make it happen”* (I14), and

regional authorities are at the right position to mobilise the regional ecosystem, having an instrumental role in involving stakeholders in pertinent co-creation processes, enable collaborative learning among actors (e.g., in piloting innovation, initiating systemic change) and increasing awareness and education to stakeholders outside of the public sector. Additionally, the regional government along with the national government, should play a key role in addressing the environmental challenges in NRBI. Lastly, regional authorities can have more strategic global role, as it was the case with the Central Denmark region, which managed to include the public sector in the global CE transition dominated by industrial actors, wanting to showcase to Ellen MacArthur Foundation that public sector should be part of the CE travel as well.

5.3.2 Division of power as common denominator for EU regions

This theme has concentrated on the division of power within the EU regions and its impact on the CE policy formulation and adoption. The fragmented legislative landscape with the main caveats was covered in the first sub-theme, while the organisational transformation of the regional administration in the context of the CE transition was presented afterwards.

Namely, the MS were categorised into three main groups, representing regionalisation and unitarisation at the two sides of the spectrum, and the balanced power distribution in the middle. In the regionalised MS the sub-national level, i.e., regions, have legislative powers. The issue of devolution should be mentioned in this regard, which is basically the transfer or delegation of power to a lower level, particularly by central government to local or regional administration. Regional autonomy is another distinctive trait for these MS, whereby regions have the legislative power to devise regional laws in certain sectors and therefore have wider range of instruments to mobilise regional stakeholders. This was clearly stated in I3 – “...in Italy due to its division of powers, regions are quite flexible and they have the freedom to even make regional plans” and I6 – “Spain for example, which has a lot of autonomous regions, and where you have regional governments, and regional ministers that are actually working on environmental issues and they have power; they have power to talk to the capital and together design their particularly strategies”. Germany and Belgium were also mentioned in this regard. However, the regional

autonomy and devolution can be also one of the main challenges and caveats of regionalised governments *“because sometimes they come to a gridlock between the capital and the region”* (I6).

Unitarisation is the other group of MS, where the legislative power is entirely concentrated at the central government level. Countries like Poland – *“in Poland it’s more like central power...each region has to follow what ministries say...we have to follow the national restrictions dedicated to the implementation of different solutions”* (I7) and Greece were referred to, and the Regional Operational Programmes (ROPs) were identified as one of the strongest policy instruments for these countries. Some of the caveats of unitarisation included the lack of regional autonomy, the limited planning capabilities regions within these MS poses and difficulties to advance centrally devised strategies, as indicated in I6 – *“regional level is just executing the commands of a central ministry, then there is little to expect, unless this central ministry is enlightened”*. On some occasions these executorial roles are given to regions without the necessary means for implementation, as it is the case with the Dutch government which according to I13 *“gives all these tasks and things to the provinces, but sometimes also without giving the means. So, whether it’s energy or pollution or whatever, you also need the means to act. So, sometimes it feels also like a way of budget cuts on national level”*.

Taking into account the presented caveats of regionalisation and unitarisation, the balanced power (both formal and informal) distribution emerges as third category because *“the truth is somewhere in between”*, where there is *“harmonious symbiosis between the local level and the central government. So, there is a good multi-level governance”* (I6). Scandinavian countries were noted as examples, like Finland and Sweden, where the *“local level plays increasingly important role in the implementation of this strategy, not only on the implementation but also on the design”* therefore *“it’s not a race against the government, it’s actually a positive action for and with the government”* (I6). These regions despite the lack of legislative power to devise regional laws are one of leading regions in the transition towards the CE, due to their strong institutional capacities, informal governance, organisation culture and value of regional authority being aligned with environmental affairs. Central Denmark region is one such example because they didn’t have any formal role in the transition defined by the central government on the CE agenda, nevertheless, as stated in I4 – *“but actually, we did take a role, because we thought that this was an important agenda...we were leading by informal power”*. Even more importantly, regions cooperated to lobby for the CE agenda to be taken onboard in the national Policy Bill in 2013

and 2014 – “we were very few working with this agenda in Denmark, we were maybe a group of 10 persons that I knew, situated all over the country to impact the political parties to take this agenda with them on the Policy Bill. And it went through 2013 and 14 with a great success actually. We got very many initiatives from symbiosis projects” (I4).

In the context of the division of power, one expert underlined that quite often the proposals from Brussels are “blind” on this dimension, hence this is disregarded in the formulation of high-level policies. However, one of the intended action areas of the established CCRI initiative is exactly to provide recommendation for policy formulation to MS and ensure exchange of knowledge and experiences.

The second sub-theme was referring to the several organisational transformation paths which some of the authorities undertook. They are presented in **Table 40**.

Shift of focus	Sectors vs. challenges: - Traditionally organised around sectors - Now organised around challenges	- e.g., South Holland - <i>traditionally we were organised around economy, living space, finances, things like that and right now there's a switch to change the organisation to the challenges. So, for instance, energy transitions, circular, digitisation” (I13)</i>
	Sectors vs. transition: - Traditionally organised around sectoral approach - Now organised around transition themes	- e.g., RVO: Netherlands Enterprise Agency, an executive body of the Dutch Ministry of Economic Affairs and Climate Policy
	Regional strengths vs. intent for transformation: - Traditionally focused on regionally strong industries - Now focused on all SME's wanting to transition towards CE	- e.g., Central Denmark region - <i>“we have been working with that part what are the strongholds of the region... when we went into the circular economy, we actually left that part and said that what we wanted to guide, to work with the companies that actually wanted to make a transformation, wherever they came from. We didn't want to address a special you know, the building sector or the steel industry or whatever, we wanted to address the companies that actually wanted to make a transformation and wanted help” (I4)</i>
Shift of ministry's competences: - Traditionally ministry of environment pushing CE agenda - Now all ministries have competences in CE matters		- e.g., Catalonia - <i>“at the beginning it made sense because it was the departments and ministries for environment that were pushing to move this circular economy strategy, but now all the ministries have competencies on that” (I17)</i>
Shift of short-term effort: - From changing the organisational structure - To having a clear CE vision and pursuing it		- General observation - <i>“we need to decide where we put our energy, because the organisation that we have, is the one we have. So, in the short term we are not going to change that. So, with the organisation we have, we need to find the strategies to accelerate the transition” (I17)</i>

Change of mindsets and perspectives: - Focus on what you can do, not on what you cannot do	- General observation
Overcome silo mentality/modus operandi of projects: - Focus on the challenge, not on the competences	- General observation

Table 40: Organisational transformation of regional administrations

The last sub-theme is related to the effort to change existing dynamics through transformative action, in order to indirectly change the prevailing institutions. The rigidity of institutions and inflexible organisational structures were mentioned in this context, as well as the insignificance of the level issuing the regulation for the stakeholders; what matters is the availability of funds, directionality, and new regulations that *“indicate that the landscape is changing”* (I17). Furthermore, with the competences they have developed so far, regional authorities have the responsibility to mobilise stakeholders and make good use of the available funds, so that *“each institution has to think what is their role and how can they empower these connections in the local level, so that these stakeholders get all the opportunities”* (I17). Finally, in cases like Central Denmark region, the regional government leveraged on informal governance to address pressing environmental challenges and push forward the CE agenda.

5.3.3 Multi-level governance mechanisms

This theme focused on the need of having a unified narrative towards the CE transition through the existence of functional and efficient multi-level governance mechanism; including vertical and horizontal governance imperative, as well as the existing institutional structures and capacities within the region itself.

The vertical governance imperative emerged as highly important for the CE transition and in this respect the balanced distribution of formal and informal power played a dominant role. The example of Scandinavian countries was referred to in I5 as having very functional vertical multi-level governance mechanisms and balanced power distribution, of both formal and informal powers. This was ably introduced in the Central Denmark region case, during their organisational transformation process (see **section 5.3.5** for more details) by contrasting how two main strategies were developed; the Regional Innovation Strategy formulated more than

a decade ago and the recently formulated strategy for sustainable hospitals. The first one was developed mostly by use of informal power where the region *“could actually function a little bit like agents under the radar”*, while the latter one was developed in a more formalised way with a lot of *“attention from the direction. And when you have attention from the direction, you are a lot more careful and a lot more, you know formal in what you’re doing”* (I4).

The lack of coordination was particularly emphasised in the case of Slovakia as an impediment to advance towards a more circular future, by decelerating the transition process and increasing the complexities. Hence, the establishment of some type of coordination body was deemed indispensable *“we will have to make this coordinating role and I think without this step, it will not make a step to make it better”* (I11). In order to tackle the lack of coordination issue, the CCRI CSO (Coordination and Support Office) was established by the EU, and this was the core of what was envisaged for this consortium to do. On the contrary, in the case of Catalonia the focus was put on ensuring directionality and transformative action, rather than coordination:

“We need all levels - the global, the European, the national, the regional, the local. But it’s not discussing about how they coordinate, because this is an endless debate. The important thing is that there is a clear directionality and that in each level the actors know... So, how can we make that all the stakeholders have the incentive to work in the same direction, without the need of coordinating everything. Because coordinating everything is impossible... less coordination and more transformative action. Because we lose a lot of time trying to coordinate everything possible and at the end, we forget the action” (I17).

For the regions with legislative powers, like the Marche region, in the context of vertical cooperation between higher and lower governance levels the region holds a strategic position and therefore has a critical task to transfer strategies from the EU to local levels. In the case of Slovakia *“missing cooperation between national level and regional levels”* (I11) was identified as one of the main barriers for the absence of regional CE strategies. The Galician Circular Economy Strategy (2020-2030) was not developed on the initiative from the Spanish national government, but not because there was a *“problem of lack of consistency, or harmonisation, or dialogue between different levels of government, or administration”* but because of policy prioritisation issues - *“in the Spanish government there were other priorities, because of the political agenda”* (I1). The need to reinforce the cooperation with the municipalities was highlighted in I11 – Slovakia and I4 - Central Denmark region; the latter by using *“informal governance”*

managed successfully to do that by targeting an agenda of high importance for the municipalities:

“We had to like make ourselves interesting by feeding into some kind of agenda that was crucial to them too...So, in order to take lead, you had to get a sort of, you know a movement, mobilisation instead. We were leading by informal power or whatever you call it, and we had to make a movement and you know, make the issue so interesting that the municipality would actually deal with us. So, that was why we involved them all the way around, and also involved the Danish Federation of Industries and other organisations, where we introduce their members (I4).

Slovakia on the other hand, faced difficulties due to the lack of directionality for the CE transition coming from the national level, as put forward in I11 *“the national level do it one way and the regional level do it in the different way”*.

The horizontal governance imperative among different regional authorities and provinces was also stressed as instrumental for the CE transition in several interviews. In this setting, *“the regional level is so efficient, as the particular regional governance is developed” (I6)*. In the case of Italy, which is a MS with legislative powers at sub-national level, regional authorities have to oftentimes coordinate multiple regional strategies – *“the regional level has like a coordination task among all these energy and environmental adaptation plan” (I3)*. The knowledge sharing among different provinces was emphasised in the case of South Holland, as well as the supporting role of the Dutch Interprovincial institute :

“I think there’s more to gain in terms of collaboration with neighbouring regions or neighbouring provinces...we work together in an interprovincial institute, but I would like to see if there’s good breakthrough projects happening in other provinces, we should implement a strategy to adopt them quicker, better, and vice versa – so, we can also give back something...and also specialise a little bit, so we don’t need to invent everything ourselves.” (I13).

A similar situation was presented in Central Denmark region, where they have the Danish Federation of Regions being very active in climate related issues in terms of cooperation on projects but also measurement and monitoring efforts for the CE transition.

Lastly, in the CE transition it is fundamental that the interplay between all governance levels is maximised. In this context the EU plays a central role, by pushing for collaborative learning (e.g., I14 - *“it’s not about not knowing what is around, it is about us wanting Europe to push for collaborative learning”*) and brining all relevant stakeholders together for knowledge exchange (e.g. I14 – *“it’s how do we make this big jump and how can Europe bring the relevant people together”*).

This was clearly outlined in I14 where the example of the city of Prague was brought up and the feedback they provided: *“I don’t need yet another advice on what I can do, or tons of report, I want Europe, or we need Europe to bring stakeholders together so that we can learn from each other, that we use in a smart way the knowledge that is available and we see how we can really do this big shift on a bigger scale”*.

The institutional structure and environment in the regional administrations proved to be vital for the development and adoption of CE policies, because the collaboration and trust required to undertake CE initiatives are fostered locally – as put forward in I17 – *“one thing that is key is that the collaboration, trust, relations, how to organise...it happens at the local level”*. The need to reinforce collaboration locally was also noted as crucial for having functional institutions. Particularly the role of researchers was emphasised in overcoming some of the main barriers and silos in implementing CE policies and projects. The different objectives and approaches that the Triple helix actors (industry, academia, policymakers) had during the development of the Polish Bioeconomy Roadmap was highlighted as one of the main barriers that needs to be bridged by setting up joint objectives. Another essential issue to be addressed is to ensure perpetuity between political cycles, especially at the local and regional elections where *“there’s new people coming in, and they redefine things and you do the same work with the previous people did, and there is a waste of time and resources”* (I2).

The importance of having well developed capacity and leadership skills at the regional level to envisage long-term vision and actions was also stressed. In that context, it is crucial that regional authorities are feeling agency over their own future. An example of this is the unceasing determination of the Central Denmark region to vouch for early inclusion of the public sector in the CE transition by showcasing to the Ellen MacArthur Foundation that public sector should be part of the CE travel, as well as their ability to cooperate for lobbying on CE agenda inclusion in the national policy bills.

In some cases, lack of regional capacities to plan, design and execute CE strategies was noted, as well as the uneven availability and distribution of skilled public servants in regional authorities (e.g., I19 - *“in Flanders we have 100 people working on circular economy while in Sicily they have no one, not one working on the transition”*). Another participant made the argument

that it's irrelevant the level at which the capacities are developed, what matters is that they exist at some level:

"it's important that these capacities exist at some place within the country; it could be that the best place for it is in the region, but it could be that the country for whatever reason may be small enough or may have a different political tradition that argues for these capacities to be situated in a national authority. The big problem I see is that managing capacities are missing in some countries, irrespective of level of governance. In Greece for example, they are missing at all levels, which is very troubling, very, very troubling, and that efforts have not been made all these years to invest in their capacities" (I18).

An investment in human capital and tools needs to be made in order to address the lack of capacities of regional administrations, through investment in *"capacities to anticipate the future, to coordinate the policies with other domains, to monitor and evaluate them"* (I18). Available instruments within the Cohesion funding were mentioned in this respect, and the peculiar fact that many of those regions that need it the most are not taking advantage of them. This was explained via the *"interaction between variables such as political autonomy or devolution, and the extent to which regions can feel that they have agency over their own future, and the readiness to invest in their own capacities"* (I18).

Last but not least, regional efforts for establishing a transversal coordination unit extending beyond departmental borders, therefore adopting a holistic and systemic approach in the traditional departments at the public institutions was mentioned; hence, *"it's not about creating another new institution per se or a coordinating body. It's more about really connecting the dots"* (I14).

5.3.4 Formulation and implementation of developmental strategies

This theme mainly presented the approaches for formulation and implementation of developmental strategies, including the regional CE strategies within the EU context. The top-down approach of strategy development and implementation is characterised by the use of regulatory instruments, economic instruments (incentive or penalties) or education and capacity building. However, this approach might not get full attention and acceptance from all stakeholders in order to yield positive results. The bottom-up approach is based on local demands and natural interest of the local stakeholders, hence its similar to local resource scenario where local activities, customs, culture, resources, and capacity are having decisive role. The caveats of the bottom-up approach include the long-learning curve and ultimate

target achievement after a long process full of difficulties. A third approach, not recorded in the academic literature so far, is the side-way in approach, combining benchmarking and leapfrogging, therefore relying on mimetic pressures. Within this approach, one is looking for best-case examples or best success stories in a similar scenario, regardless of the economy and industry. By doing benchmarking, past mistakes are omitted as well as void investments, i.e., leapfrogging. Typically, an expert or consultant is involved in this exercise for guidance, therefore targets are attained more effectively and efficiently. Lastly, the EU back casting development strategy approach was also mentioned, as well as the term roundup.

High-level trends started influencing the formulation of developmental strategies. Determinants such as import substitutions, origin and impact of foreign investments will have even greater influence on the future developmental strategies, considering the increasingly polarised world and the tendency of Europe to become even more interlocked.

The complex environment and length of the EU legislative decision-making process was also mentioned, as well as the new protocol according to which CoR and ESC are consulted on certain matters, but their opinion is not legally binding.

5.3.5 Architecture of regional CE policies

This theme focused on exploring the arrangement of the regional CE policies. More particularly, on the different policy configurations in which CE appears as an element or a standalone policy, and the distinctive scenarios which led in one way or another the initiation of a CE policy. Furthermore, the varying stages of CE policy implementation among the EU regions were presented, along with some of the main issues encountered.

Overall, the interviewees agreed that having a regional CE strategy or policy is beneficial for a region, mainly for two reasons. The first one is because it's providing an overall vision (e.g., I3 and I8), and simultaneously it provides directionality (e.g. I1), *"because the key problem we have in a lot of these transitions is directionality. Are we all going in the same direction? Is there an open trance process where everybody can engage? Is this something where the public sector is an example, but also is enabling others to go in this direction?"* (I16). Additionally, with developing a regional strategy, the region can leverage on funding indispensable for transition, because *"without funding you cannot have a real transition"* (I9). Nevertheless, the interlinkages between

existence of regional CE policy and level of CE advancement were characterised as nuanced by one participant, because on one hand *“having an action plan or having a strategy is not per se a parameter for success that actually things are being done”*, on the other hand *“some regions who don’t per se have a CE Action Plan, but who are in a particular field, for example waste, very, very, very advanced”* (I14).

Some essential determinants which need to be considered during the formulation of regional CE policies emerged. Namely, there is no *“one-size-fits-all”* solution, and the place-based approach needs to be entangled, since *“general principles probably apply to everyone, but the place-specific questions have to be dealt locally”* (I5). According to I7, *“the most important element in the implementation of the CE now, is on the regional scale. Because each region is different”*. This was evident in the case of the Galician CE strategy, where the main focus was on food value chains, because this sector is very important for the region. The systemic changes required for the CE transition were also mentioned, as well as the need for system boundaries delineation. General EU guidelines in this respect were deemed as helpful both for regional and sectoral scale (I7). Certainly, these strategies have to follow high-level EU goal orientation, as stated for instance in I11 - *“we have to fulfil the goals of the European Commission or European Union as a whole”*.

During the development of some strategies, like in Galicia, Central Denmark region and Slovakia, the accent was on the feasibility of the policy (e.g., I4 - *“we tried to make it with principles, instead of writing an intellectual academic document on 20 pages that nobody reads”*). Furthermore, the local ownership of the CE agenda was implied, like in I2 - *“because if we talk about circular economy and we speak about local, to an extent possible of course, or regional supply chains, networks, collaborations, then there has to be some kind of a regional policy perspective in these discussions. Otherwise, by just having high-level policy strategies at the EU or national level, I don’t think you can have this impact in the end”*. Last determinant to be considered, particularly for the national level is to provide overall framework where regional authorities can innovate based on their local situation and trying to strike the balance between compliance and *“room”* for innovation.

The policy configuration sub-theme aimed to categorise the regions based on the existence of a regional CE strategy, policy or action plan and its specifics. For instance, the region of Galicia has a standalone CE policy, the *Galician Circular Economy Strategy for 2020-2030*, and according

to I1 it has a twofold aim – to be aligned with the main EU policies and the regional S3. South Holland region also has a standalone CE strategy, but recently they developed a very industry specific strategy looking at the regional logistics hubs, like the Rotterdam harbour in the CE transition. Brussels Capital region is another example of a standalone policy, *Brussels regional circular economy program of 2016-2020*. Catalonia has many regional policies addressing environmental issues, but the most relevant strategy is the *Bioeconomy strategy*. Additionally, the Catalanian S3 for both programming periods had CE as a transversal priority and therefore, central element of S3.

The Region of Central Macedonia doesn't have a CE policy, but it has two related action plans resulting from ad-hoc EU projects, *Action plan for promotion of circular economy within the SME's* and *Action plan towards biobased circular economy*. Furthermore, CE is one of the priorities of the National S3, and indirectly of the Regional S3 since they both have to be aligned. Marche region likewise doesn't have any regional CE strategy, and according to I3 has no intentions of developing one soon. Nevertheless, CE is quoted many times in their regional S3 as one of the main sectoral drivers. Similarly, the region has a "*Regional Law on the Industry 4.0, which is a plan to promote digitalisation, modernisation, and sustainability of businesses and the enterprises, and the circular economy is also a relevant part of this*" (I3). The twin transition, green and digital, was additionally brought up in other discussions (I6 , I11, I16). Slovakia is another example where regions don't have developed their CE strategies, but the current National S3 (*Research and Innovation Strategy for Intelligence Specialisation of the Slovak Republic 2021-2027*) is containing CE elements. The previous National S3 was "*just a framework document...but it was not elaborated enough*" (I11). In the context of this, according to I12, CE should be a central element and priority for the S3.

Upper Austria has a wider sustainability agenda, called UpperVision 2030, but furthermore has a roadmap for the plastics value chain. Central Denmark region has a wider *Sustainability Strategy for 2030*, where CE is one of the main focus areas, and moreover they have a Sustainability strategy focused on the plastics value chain in hospitals. In other instances, like Poland, CE policies on other levels like national and city level (Krakow, Warsaw, and Gdansk) were mentioned, despite the existence of few regional policies in Malopolskie and Śląskie region.

In the third sub-theme the diverse scenarios among the EU regions were presented which led to initiation and formulation of CE policies or related activities. In the case of South Holland region, the CE strategy development was influenced by two factors from political nature. Namely, the last provincial elections had a deputy with CE related political agenda, combined with the organisation transformation resulting in shift of organisational structures and modus operandi. The latter one was also quite deterministic for Catalonia, where a shift from an overarching CE regional policy to integration of CE elements in wide range of existing regional policies was observed. Both cases are result of regional initiative and they are further elaborated in **section 5.3.2**. The Galician government was another example where the regional government contracted the formulation of the strategy, following the priorities coming from the EU. The policy formulation was initiated by the regional government, drafted by three universities, considering the feedback of the Triple helix actors, industry, academia, and government, but omitting the involvement of societal actors (also elaborated in **section 5.3.8**).

Central Denmark region was another example where CE related activities were undertaken even in 2010, originating from the genuine interest of the regional authorities in the CE agenda. This was founded on normative and innovative approaches to mobilise the regional ecosystem, by initially establishing a platform enabling to work on CE related issues. The outcome of this was their first strategy, called Innovation Strategy, developed following a co-creation approach. In parallel, the region was working with SMEs, by initiating program for SME's interested in CE transitioning. According to I4, this "Rethink Business" program was very successful and became *"the basis on how we work with circular economy in Denmark's SMEs actually. It has been running for 10 years, also after we had to close our business down in regions in 2017, this still was running on a national level"*. There were also very effective vertical governance mechanisms for cooperation, because the region was also engaging the municipalities by providing municipal funding for CE related projects, involving Triple helix actors, and municipalities had the obligation to include these CE actions into their municipal strategies. This specific initiative *"was aiming to showcase into the municipalities that circular economy should be a part of the strategy"* (I4). After a few years, the region *"thought that it is not enough to work with the SME's"*, hence they shifted their efforts towards value chains, with the goal that *"every partner along the value chain should gain value from cooperating towards circular economy"* (I4). Therefore, they identified "piloting" areas for testing and gaining knowledge

to use it in broader areas afterwards, focusing on a project on plastics packaging in hospitals. And this specific decision proved very impactful, because *“it was this project that made it possible for us to make a Sustainability Strategy, that has now been developed at hospitals and is spreading all over Denmark again” (I4).*

In other occasions, certain regional policies were formulated following a top-down conditionality, either coming from the EU or national governments. The Sustainability Strategy 2030 of Central Denmark region was a legal demand coming from the Danish national government. The existence of related EU initiatives aiming to foster regional transition towards CE were recognised. According to I17 *“the European Union has introduced many policies, mandates, incentives to do this change and regions always look the direction of the European Commission”*. The Galician case, as presented above, was an example where these EU policies and priorities were more influential than the national ones, pointing out to a potential disjuncture of the transposition process. Nevertheless, the impediments for these EU initiatives reaching all regions simultaneously were also highlighted since this will require a particular governance structure and more focused approach targeting specific areas (I2 - *“I doubt that something at the European level can come and reach all regions in Europe, at the same level. I think it’s impossible...But, that doesn’t mean that you cannot have networks and stuff. But the networks are going to have some reach out, they are going to focus in some areas, they’re going to bring some communities together. But reaching all of the communities together - this is practically impossible”*). In this context, it was noted that there is also an upward channel of influence, because the actions of the regions are affecting the EU policies in turn. This top-down conditionality is inevitably increasing the compliance and requirements at regional and local levels, which bears the risk to strangle the innovation, as stated in I6 - *“when they are overloaded with compliance, you cannot expect them to come up with a fresh strategy”*.

Poland was another interesting example, where due to EU law the countries were obliged to have National Waste Management Plans as well as Regional Waste Management Plans, and recently regions started converting the latter ones into regional CE plans, as a response to the latest developments. However, these plans are very sector specific, mostly focusing on waste management, industrial and municipal because *“it’s the easiest way to report that we are doing something good” (I7)*. Additionally, sectors like plastics and food waste were included, while reduced activities in the area of sharing economy were noted during and after the pandemics.

The importance of the consumption side was also addressed, mostly via environmental educational and awareness raising campaigns, while the pressing issue of water management remains unaddressed on EU level. Despite the lack of regional CE policy, Marche region has scattered CE related activities undertaken within different EU projects. Finally, one participant pointed out to the difficulties in identifying the exact initiator of the regional CE policy generally, *“because you have to be in the national politics and follow the debate to know exactly what was the outcome”* (I2).

In the last sub-theme different stages of CE policy implementation among regions were presented, along with some of the main challenges regions are encountering. Catalonia region was one of the most advanced regions when it comes to CE adoption, where *“circular economy is becoming business as usual already”* (I17). The CE policy has already penetrated in a wide range of existing regional policies, and there is integration of the CE concept - *“now circular economy is everywhere. So, there are many strategies that integrate circular economy”* (I17). Western Macedonia region is in the process of formulating regional CE policies. Similarly, Slovakian regions will need to devise regional policies due to regulatory compliance in the current programming period 2021-2027. Two interesting points raised for Slovakia in I11 were the example of a local ownership of the CE agenda on one side (i.e. *“very small villages and also big cities want to make some processes that are linked with circular economy”*), and the rigidity of the state apparatus on the other side (i.e. *“many things in the national level lasts very long... the state is not very flexible and not very fast in these processes”*).

The CE concept started penetrating in related policies and discussions at the regional level, however there is still a time lag between West and North Europe, compared to South and East Europe. For example, CE related discussions that have existed in Brussels since 2013 only now started appearing in Western Greece (I2). Despite not having a CE policy, the CE concept started penetrating in related policies in the Marche region, as well as different scattered CE activities have been undertaken within EU projects, like the establishment of the regional reuse centre.

In other regions there is lack of realisation observed due to different reasons. The immaturity of the CE concept was raised not only in Malopolskie region, but in Poland overall. This is clear from I7 - *“we have a lot of different stakeholders who came to us and ask what we can do for a*

circular economy, and if we are in the line of the circular economy, they didn't know about it. They did know that there was circular economy, but they didn't know how it works". In the case of the Region of Central Macedonia, lack of realisation was also observed, partly because the CE term is "not very mature yet. And there are many stakeholders in the Region of Central Macedonia which do not understand exactly what the term means in practical terms" (I9). Additionally, there are difficulties in the CE implementation on the industry side, since SMEs seem disengaged with the CE agenda, as stated in I9 – "they have to use the funding in order to finance a real need of their business plan and business model. Not sort of, create a business model in order to get the funding".

In other instances, like for Galicia, policy prioritisation issue was observed, because of the political agenda – *"the problem of the priorities at the central government were different, because the political environment was a bit crazy in the last decade" (I1)*. For the South Holland region lack of regional enforcement mechanisms were noted, since occasionally tasks from the national government were delegated without adequate budgeted allocation for implementation. According to I10, there is lack of CE realisation on EU level, the technology is available, but the market is not adapting and purchasing it to enable higher circularity rate. Lastly, perplexity of inception point was noted for Upper Austria (i.e. *"Upper Austria is really focusing on circular economy right now, and we suffer, we suffer from...I think we do not know where to start...we do not know where to start on a concrete way", I8*) and Poland (i.e. *"I think that many of regions not only in Poland, but also in other countries they don't really know how to start with their CE implementation, like you know the official regional scale", I7*).

5.3.6 S3 & CE nexus: influences, risks & mitigation mechanisms

This theme focused on investigating the nexus between S3 and CE, trying to uncover initially the direction of influence between the two strategies within the EU regional context, and subsequently to identify the nature of influence. A less deterministic relationship appears to exist with several risks of adverse influence, and respective risk mitigation actions need to be considered. Additionally, the overall formulation and implementation aspects of the S3 have been covered.

Some remarks regarding the survey were made initially. Namely, the ambiguity in the formulation of the questions related to the links between S3 and CE was highlighted in I5

(*"The question is as I see, "S3 can positively, CAN positively influence"- I think that all of us responded in the sense that it could... So, in that sense - yes it can. Does it? Well, not so clear. But it could? Yes, it could."*) and I12 (*"I mean the answers you've given "regional CE policies can positively influence" well I think they can yes, it doesn't necessarily mean that they do, so it depends how people have interpreted these answers. They can positively influence, but I would also say they can negatively influence, and the question is what they do"*). Another observation was made in regard to the participating regions in the survey, as being the "usual suspects", also very active on the S3 agenda as well. And the ones that didn't participate in the survey have issues overall in setting up and running the innovation agenda. Additionally, the background of the survey respondents shall be taken into consideration, because for instance if *"the S3 manager is answering your questionnaire, he of course will say that the S3 is positively influencing the regional CE policy, because that is the obligation of the S3 as part of the enabling conditions for receiving the structural funds. He cannot say something else"* (I16). Another participant added that the survey results are demonstrating the extent of ownership which survey respondents feel with S3, which suggests *"that they are not in a position to consider the possibility that it can, or it has negatively influenced the adoption for more sustainable approach to regional development"* (I18). Furthermore, he clarified the distinction between the concepts of CE and sustainable development and advocated the use of sustainable development, *"because they may think of CE initiatives as a label, a package of tools, including the classification schemes and so on, that you can mindlessly adopt. But sustainability, a truly sustainable approach to development requires considerable adaptation and this rests crucially on institutional capacities to do so"* (I18).

The direction of influence was the first point to be uncovered in the survey and interview stage, hence four main alternatives were provided: 1) S3 is influencing the adoption of regional CE policies, 2) regional CE policies are influencing the formulation of S3, 3) mutual influence or 4) disjuncture between the two strategies.

According to I7 S3 are shaping the CE policies because they penetrated earlier in the EU policy framework, reaching some level of maturity and stability which can hardly change drastically, so S3 should be also included in the CE. Whereas I12 presents S3 as rather non-compulsory element of the CE policies, stating clearly *"I don't think a circular economy approach necessarily implies a smart specialisation strategy"*. A connection is made based on the regionally oriented funds for green objectives, and the leverage regions can take on these S3 funds for accelerating

the CE transition. The example of Malopolskie region was mentioned, where bioeconomy is regional core industry, and the related regional calls are dedicated to support bioeconomy. Therefore, companies with activities in bioeconomy are encouraged and accepted in the calls (I7). The Region of Central Macedonia (I9) and Catalonia (I17) are also trying to leverage on S3 funds for progressing on the circularity side – *“there are lots of projects, but we are trying to use the smart specialisation strategy to accelerate things”* (I17).

Conversely, other interviewees shared the view that the increasing importance of the CE and regional CE policies are influencing the formulation of the S3, which was supported by concrete examples. The S3 of Central Macedonia region is containing certain CE elements, and the Regional Development Strategy of Central Denmark region also has CE as part of the strategy. The Slovak RIS3 for 2021-2027 is directly linked to CE, as one of the main topics within the strategy. In the case of Marche region, the S3 is integrated with horizontal strategies, like CE and digitalisation. The S3 of Catalonia for both programming periods has CE as main central element, in a form of transversal priority, as described in I17:

“if you look at our new strategy is oriented to transformative change only and it talks about 7 shared agendas for transforming the food system towards sustainability, but also justice and these kind of things; there is another strategy for natural resources also, to make a more sustainable use and respecting more the nature and putting as priority the planet and all these kind of things; and we have another of transforming the health and social system and another to promote that the industry really makes the transition towards sustainability, incorporating the CE and trying to generate new business models. So, the strategy is all about this. So, CE is central in this strategy”.

Similarly, I12 argued that *“the priority would be for smart specialisation to embody the CE as ways of thinking, to build up a strategy where you’re building complementarities which are between green and inclusive and smart...that they all become part of the story”*. For the Galicia region the food industry is one of the core industries, and according to I1 there was also sensitivity regarding environmental issues in this specific industry, *“so, there was always that thought about the relevance of CE for our region”*. S3 was perceived as instrument for overall sustainability strategies, and the shift of priorities from competitiveness and specialisation to SDGs and CE was underlined, with the claim that *“in the new period it will be difficult to find any S3 that it’s not related to CE”* (I17).

The survey results showed the majority of the respondents considered there is a mutual influence between S3 and regional CE, which was also validated by the answers of the

interviewees (e.g., I2, I6, I8, I11, I13, I14). In this respect the connection and alignment between *“different priorities per region and the CE goals set on a national level”* (I15) was brought up, as well as the dependence of their degree of alignment on the period when these strategies were formulated (i.e. *“in Greece we had our first CE strategy in 2018, while as you say the other western European countries, they did have a CE strategy much earlier, which enabled also the regional strategies to be aligned and so, you know implement all these activities much earlier than Greece”*, I15). According to I6 there is a constant interplay between the two strategies which needs to be considered, and this is becoming more widespread lately, due to increased awareness of the CE idea. Moreover, an overlap between the two concepts was noted, having some of the main principles of S3 (e.g., *“innovation, education, bringing business solutions to the markets”*) being at the heart of CE, combined with evolution of ideas across the two strategies and *“because sometimes of the same people being involved in both discussions in a way”* (I2). CE was defined as *“one of the flagship initiatives of the Commission”* which is obviously influencing the S3, while regions need S3 to obtain EU funds (I14).

Lastly, there were the opinions of disjuncture between these two strategies, for two main reasons. The first one was due to the ambiguity in the S3 policy scope – *“there is no clear definition that circular economy is part of the smart specialisation strategies”* (I5). The second one was due to the differences in the optimal implementation level, the S3 is designed at regional level since its dealing with regional strengths, while CE policies are designed at more strategic geographical level. This was indirectly tackled in I14 when describing the risk of adverse influence between S3 and CE due to the inter-regional dependency for some value chains, further elaborated in the following section.

The nature of influence between S3 and CE was analysed in this sub-theme, presenting three possible scenarios of: 1) positive influence, 2) risk of adverse influence as well as 3) the possibility to have both positive and negative scenarios based on how each region is addressing certain dynamics. The positive links between these two policies in both directions were supported by I6, and I12 presented the possibility of having a positive path dependency situation in a region and *“that’s probably a good thing”*. Two interviewees, I3 (Marche region) and I1 (Galicia), described the relationship between S3 and CE as very complementary at a regional level, I1 adding – *“I think at least in the case of Galicia, I think there is no problem, no incompatibility, I think they are very well aligned, one with another”*. Lastly, I17 (Catalonia) justified

this categorically positive links to the EU regulation which is binding regions to orient funds for green transition – *“regional policies are obliging regions to be more ambitious in relation to the green transition. So, it’s not negative, it’s positive. Because without that, many regions would not be here, especially in less developed countries. So, it’s the European Union with the regulation of the European funds which is obliging all these regions to orient a lot of funds towards green transition. So, in this sense it cannot be negative, it can only be positive”*.

The risk of adverse influence between S3 and CE was supported in several discussion (I5, I9, I12 and I18), elaborated below. Particularly, two problematic trajectories were underlined - the risk of regional lock-in in liner supply chains and the possibility of a region to end up in a negative path dependency situation, both cases mentioned in I12 and I18. According to I18, the biggest risk of regional lock-in is emerging from the unfit heuristic of S3 in prioritising areas of regional strength, which are in economic activities that are often unsustainable in some fundamental dimension, therefore, not fit for the purpose of a broader sustainability transition. This risk is presented in more details below in the section and supported by examples. Potential production cycle lock-ins due to geographical and geopolitical factors were introduced in I6 – *“they cannot implement what they think, because they have constraints that are linked with supply chains, with value chains, how they produce things, they are actually sometimes locked-in in some particular production cycles, that they cannot really easily forgo; because of geographical reasons, and increasingly of geopolitical issues”*.

I13 acknowledged the possibility of these relationship to develop both in a positive but also in a negative way, by describing the example of South Holland region where there is a large harbour area with a lot of chemical industry. Therefore, according to I13, this strong regional cluster is simultaneously *“keeping space occupied that we might need to use for circular activities. So, our strong specialisation in this harbour and chemical industry fields, is not necessarily a positive influence on the CE”*. Hence, the region’s strong industrial cluster is incompatible with CE in fundamental aspects, and even though there is room to implement certain circular activities, this will *“need to fight into the existing system”* (I13). In the case of Western Macedonia region an adverse paradox is happening, where the energy sector, one of the vital sectors of the regional economy heavily linked to CE, is not supported by the regional S3, hence risks can arise from this relationship.

I12 and I14 identified analogous risks, related to the regional supply chains limitations. Specifically, I12 referred to the economic and environmental inefficiency determinants which sometimes can be against for developing regional supply chains. The example of recycling technologies, especially the permanent magnets which exist in motors, was introduced to support this claim, asserting that it will be impossible to have facilities in every region because *“you have to develop scale in order for this to be economically feasible”*. Similarly, I14 referred to the inter-regional dependency for some value chains and the complex interplay required beyond regional level. On one hand, the limit of the S3 is the geographical boundary of the region, while on the other hand *“when you look at some value chains where does raw material come from, how do you organise it, who is using it, this requires sometimes a more complex interplay that go beyond the level of region”* (I14). Lastly, a risk emerging from the S3 thematic platforms and priority areas overlooking the transition was identified. The Netherlands put the focus on the transition itself, and this really boosted the speed of the CE implementation. Namely, I19 states that *“there is the risk to be too specific in all the technologies and somehow not allocating enough resources in what should be the glue between all the different technologies and sectors, what brings them together”* – which is cross-sectoriality; and currently there are no dedicated themes and resources supporting the cross-sectoriality and the transition part in particular.

The possibility of S3 and CE having both positive and negative influence was presented through the prism of trade-offs and complementarities in I12 – *“So, my answer would be “can CE policies, can they positively influence formulation of S3?” Yes. “Can they negatively?” Yes. To me they both are correct, it depends on how these things are articulated and particularly how people think carefully about the trade-offs and complementarities”*. The success parameter, further elaborated in **section 5.3.7**, is whether CE activities can be applied at scale, over long-term commitments in lagging behind regions, and not just in economically advanced territories.

Another determinant is based on how regions interpreted S3, which in turn influenced how efficient (or inefficient) links were established between S3 and CE afterwards (I16, I17 and I18). Namely, if regions have been interpreting S3 narrowly, perceiving it as a regulatory obligation and administrative procedure to obtain EU funds (e.g., *“as a box ticking exercise, to be able to have access to Structural Funds”*) they cannot make efficient links also between S3 and CE (I16). This was also validated in I18, where the evaluations of S3 and their impact in the last programming period done by JRC Seville are revealing that *“many of the opportunities that the*

introduction of these strategies presented to mobilise resources beyond the ERDF to coordinate these resources with other European national or regional funds, so as to amplify their impact, many of these opportunities were not taken up". This silo approach in governing S3 in some MS was also addressed in the last sub-theme. On the contrary, some regions have captured S3 as transformative strategy incorporating innovative approaches, therefore comprehending "the strategic aspect behind the strategy, and the way it treats the green transition" enabling to "understand better the linkage" (I6). One great example was the region of Catalonia, presented in I17 "in the case of Catalonia, and I talk about our case that it's different from many other cases I would say, because we really think that this is a strategy that should capture...it's like a transformative strategy in the sense that we incorporate innovative approaches, and we work with the different ministries and stakeholders in order to accelerate this change towards sustainability."

The constellation of stakeholders also proved as vital in determining the nature of the relationship between the two policies. Ultimately, the monopolistic situation where key industrial players are dominating the transition needs to be avoided, and inclination towards a more ecosystem type of set up needs to be ensured. This is very clearly specified in I12:

"The question is: Who's doing the investing? Who's receiving the benefits in terms of grants and funding? Who's designing the overall architecture of the policy? All of these kinds of things become very important. If you've got key players that have a strong CE agenda then that's good, as long as they're not controlling the agenda in a kind of monopoly position. Because what you don't want is the people who are driving these things become the ultimate beneficiaries of them, you don't want that. You want something which is much more of an ecosystem type of setup, so really depends on the construction of these things. I mean there are potentially a lot of complementarities here, a lot of complementarities for learning, and driving development...but it has to be done in a way which increases participation, and also you don't want the usual suspects to win all the time."

This point of view was also supported in I17 – *"because these missions if they only rely on the usual suspects of the big companies, big research institutions, they are not going to change anything at the end. The stakeholders in the territory, the companies, the citizens, civil society, the administrations that they need to change their business model, their way of life"*. In practical terms, this was a risk which was identified early on in Central Denmark region (I4), where the regional authorities shifted their support from key industrial players in core regional industries to supporting SMEs which wanted to transition towards CE. Hence, a supporting point was made, elaborated in **section 5.3.7**, that in order to have green transition, big companies which are lobbying the CE agenda needs to be addressed. This incentivising role of regions in the CE

transition was also highlighted in I9 in the region of Central Macedonia (*"this is what we're trying to do as a region - to establish links between the regional ecosystem"*) and in I17, during the implementation of the Catalanian S3 where CE was identified as transversal priority and central element (*"we are trying to implement new methodologies and new ways of working together, governments with companies, with universities, in order to accelerate these processes"*).

In the following section, some of the main reasons for regional lock-ins are presented. The first two reasons, which were presented as being interlinked, are stemming from the ambiguity of the CE and S3 concepts, hence vagueness in the related strategies and undefined boundaries. As stated in I2 – *"because both of these concepts are a little bit abstract, and they can be interpreted in different ways. And you know the definition of circular can either be vague sometimes or can include many different things that are not aligned together in a coherent way, and not backed by concrete indicators and targets. If this is the case, you cannot monitor the progress in four or five years, and then there is another political cycle, there's new people coming in, and they redefine things and you do the same work with the previous people did, and there is a waste of time and resources"*. Therefore, the second reason emerging from the first one, is the inability to ensure perpetuity between the political cycles and continuity of the work of the regional authorities. This is because the discussion has expanded from being mostly environment and waste oriented, to a more overarching discussion involving many ministries, departments, and competencies; however, in order to have a more unified direction of activities, functional governance structures and effective institutional environment are essential.

Another participant pointed out to the escalating tensions rising from confrontation of the incumbent structures and networks, which can disrupt the changes needed for the transitioning, because this will require to *"confront those that they have their potential interest, and they don't want any particular change"* (I6). Furthermore, another reason for potential regional lock-in was coming from the risk of high-level policy lobbying and monopolisation of the CE agenda by key industrial players, whose core activities are based in unsustainable industries. Additional reason was mentioned, which was emerging from the S3 heuristic of prioritising areas of strengths, which the majority of them are in economic activities that are unsustainable in some fundamental dimension. A most prominent example are the regions with NRBI, like coal regions, which exemplifies a risk that is *"not a theoretical one, it has happened"* (I18). The Coal Regions in Transition Initiative was named in this context, where a

lot of regional economies in the EU depend to a great extent on coal extraction and use, like *“Western Macedonia and Megalopolis, where a large, a double digit at least percentage of the workforce is employed either directly or indirectly in the extraction and use of coal, or in industries that are indirectly linked with extraction, like construction and various machining industries”* (I18). Taking into account that coal is their competitive advantage, in their S3 these regions have *“identified areas in need of support that are very close to this unsustainable activity, that now due to EU commitments has to be phased out by 2030”* (I18). Lastly, the current prioritisation of industries within a region was mentioned as inefficient since it is based only on the proximity to resources (raw materials); and proximity to human resources (availability of skill).

Ideally, certain risk mitigation mechanisms need to be considered in order to alleviate the risks which were listed above. In aforementioned case of the harbour in South Holland region, two courses of actions are available, to include certain CE elements in the existing unsustainable chemical industry; or to repurpose the harbour area utterly towards CE, by replacing the chemical cluster with more sustainable industrial activities. In order to address the identified risk of key industrial players in unsustainable core industries to lobby and monopolise the CE agenda, Central Denmark region shifted their focus on the interested SMEs by supporting them in their CE transition, considering that they are the biggest part of the Danish industry. Regarding the risk of problematic trajectories emerging from the unfit heuristic of the current S3 for broader sustainability transition, the PRI instrument (elaborated in **section 5.3.7**) was introduced as potential risk mitigator, according to I14 and I18. The PRI instrument is holding the premise of a new heuristic emphasising sustainable development *“that draws not just on strengths, but also on the challenges that the region faces and opportunities that could be grasped through innovation”* (I18). Therefore, the flaw of S3 emerging from the sole focus on regional competitive advantages is being addressed via the PRI by considering the regional opportunities and challenges, besides the regional strengths.

An additional action which was suggested is to introduce dedicated transition themes within the S3 platform and strategies because *“you really boost the speed of a circular transition when you first focus on the transition itself”*, like in the case of the Netherlands (I19). For the example provided above on permanent magnets existing in motors, there is a need to develop inter-regional supply chains because it's impossible to have facilities in all regions since one has to *“develop scale in order for this to be economically feasible”* (I2). This relates to the aspects of place

and distance which according to I16 are not on the EUGD radar, as well as the provided example in reference to that – *“in South Holland the chemical side there would need for a circular way of production the plastic it produces, the plastic it used again, it would need all plastic from Northern of Holland plus northern Germany”*. In light of this, the I3 instruments on inter-regional investment launched by the European Commission recently were suggested as potential solution, *“because this is about interregional cooperation, and this could compliment their regional S3 strategy. So, if you use it in a smart way, it might also deliver some solutions for value chains that start or end beyond your regional boundary”* (I14). Finally, it was proposed regions to perform preliminary risk assessment in their industry prioritisation exercise based on the industry energy consumption, water consumption and pollution impact generation.

Some general conclusions regarding the development and adoption of S3 across the EU were drawn and presented in the concluding sub-theme, beginning with the vagueness of the S3 definition raised by one participant (i.e., *“there are variety of different takes on that part, I think. There’s also something communicated by the EU, but still, it’s a lot of definitions out there”*, I4). The case study of the national and regional S3 in Greece revealed that these strategies were focused on waste management aspects with limited sensitivity to CE, they were overly ambitious to be fully implemented, and systemic delays in the applicability of the operational plans were observed. In the S3 of Western Macedonia region, the inclusion of core regional sectors related to CE was omitted – *“energy is a very important sector of the regional economy, but it’s not part, it’s not heavily supported by the S3”* (I5).

Overall, the bottom-up approach was followed in formulating the S3, emerging from the regional ecosystem – the Triple helix actors. But simultaneously the need to meet the expectations, design and the overall plan of the national authorities was recognised, because it’s the national government that is answerable to the EC and EU Court of Auditors for the regionally spent EU funds. Also, the need for institutions supporting innovation transfer to smaller enterprises was underlined, along with the shift from the Entrepreneurial Discovery Process (EDP) to the Open Discovery Process (ODP) within the PRI pilot. Two additional interviewees pointed out to the causality between the national and regional S3, implying that regional S3 are formulated following a top-down conditionality from national S3, like in Central Denmark region and Region of Central Macedonia (*“there is the national strategy, and then each region has to adapt to this national strategy”*, I9). Additionally, the formulation of S3 is

connected to the economic added value of each region, resulting from specialisation in the industries which were the regions' strongholds. Another interviewee expressed the view that ultimately the S3 are a regulatory obligation from the EU and are perceived as administrative procedure from regions to obtain EU funds – *“according to the regulation of the European Union, all regions are obliged to do this kind of strategies, and many regions adopt them because it's an obligation in order to receive European funds to invest in research and innovation. So, at the end in many regions it's not a strategy in itself in reality. It's like the administrative procedure to get funds”* (I17).

Some regional instruments for implementing S3 were mentioned. In the case of Catalonia, the regional government was providing support for technology transfer from universities to companies, offering company grants for innovation oriented towards sustainability, as well as programmes for organising labs in order to identify *“how territories can engage in the strategies that are real and people and nature, so they are circular but beyond that they transform”* (I17). The Region of Central Macedonia has established the One-Stop Liasson Office within the S3, which simultaneously provides leverage for CE initiatives as well.

A vital distinction was made between EU regions regarding the varying importance S3 has, which depends on the importance of EU funds for the region (I16 and I17). In wealthier regions S3 is only one of the many strategies available to promote transition, but economically weaker regions depend fully on structural funds, as already mentioned above. This is also very vividly presented in I16:

“In the North Great Plains in Hungary there's nothing else then structural funds. So, of course anything related to innovation, is linked to S3. In Utrecht, or in Catalonia, the role of S3 is rather small compared to other regional instruments or national instruments to promote. So, I think here my first question is who answered what? Because those who have nothing else can only say S3, those who have other things - there it gets more interesting, how important is S3 compared to their own funded strategies for some other things?”

Therefore, it is crucial to see these institutional differences in the bigger picture, in order to avoid having inaccurate and generic conclusions. Additional analysis needs to be made to identify potential patterns, and uncover these differences tied to the division of power of the specific MS and the role and importance of the structural funds within the MS (issues mentioned in **sections 5.3.1 and 5.3.2**). As for the links between S3 and CE in decentralised MS, a remark was made by I16 that this is relying heavily on the regional leadership, and

whether S3 is used for systemic change and finding directionality for the whole region, or is just a process for receiving structural funds? Similarly, a study was mentioned in this respect by I18, investigating how S3 were governed, and the related findings revealed that *“overwhelmingly there has been a silo approach, particularly in some MS S3 was not recognised as opportunity that it is for more holistic planning, but it became yet another way of managing one of the priorities of ERDF, priority one for support to innovation. So, this of course meant that the regional authorities had an important role already, but they didn’t have as an important role as they could have had”*.

Lastly, the new generation of S3 was mentioned in I6 and I18, the S4+, which stands for smart specialisation strategies for sustainable and inclusive growth. Nevertheless, this is only an academic discussion, it’s not a political one yet because for the EU only the S3 exists, the S4+ is not part of the current legislative framework. However, *“some leaders have chosen to call their regional strategy S4 as a branding exercise to emphasise that they’re taking up the sustainability dimension with them”* (I18).

5.3.7 EU Green Deal & CE policies: formulation, implementation & main challenges

This theme was dedicated on exploring the role and links of the EU Green Deal and the CE, as one of its main building blocks. Namely, the three focal sub-themes investigated were the approaches of formulation and implementation of the CE and EU Green Deal, the main challenges for their implementation as well as their potential role to act as an accelerator of the divide. Furthermore, the crucial role of the PRI initiative in the future was presented.

The EU Green Deal, adopted in March 2020, is the EU’s environmental and development strategy, and its implementation is a national competence. The funding facilities, NEXT Generation and Resilience Recovery Facility, were designed at the national level neglecting somehow the regional level – *“depending on the country, there have been activities for informing and consulting the regional authorities...but that was not a strict conditionality”* (I6). The Structural funds are another financial instrument where MS have broken-down the activities in Operational programmes, which can be geographical or sectoral. There are certain general environmental conditionalities tied up to these funds (i.e., *“requirements to spend a particular percentage of money on environmental goals”*), but *“they are not particularly focused only on the*

circular aspects of the circular economy" (I6). Circular economy is also part of the green transition, as clearly stated in the Circular Economy Action Plan (CEAP) from March 2020, however this is a very complex action involving deep, systemic changes. A common denominator for both EUGD and CEAP is the accent that needs to be put on the implementation, because as stated in I6 "implementation is everything! Look what is the moto now of COP27 - it's together for implementation. I mean, because people are really fed up with reading reports, and reading resolutions. They want to things to happen at the local level". Another important opinion is that there is now a political momentum at global level for place-based policies, considering that the USA is also launching a place-based industrial policy.

Both the EUGD and the CEAP are formulated and implemented following a very top-down approach, which certainly has the advantage of providing a unified directionality. But without the bottom-up approach a lot of conflicts and frustrations are generated; hence we need more balanced interventions and *"we need to find more effective ways of this interaction between the top-down and the bottom-up, because we need them both" (I17). The very top-down approach has the tendency to be auspicious for the already advanced regions, neglecting the needs of the weaker ones, as clearly expressed in I12 – "this was always an issue around the Green Deal because it's very top down, and top down tends to land itself to certain types of places. The challenge is - can these things be getting in these other settings?". Additionally, the increased environmental top-down conditionalities related to the EUGD funding instruments are rising the risk of squeezing out innovation due to additional web of requirements, leaving regions with fewer degrees of thinking freedom. The comparison between the "chimney" vs. "trickling" effect was introduced in that respect in I12 – "the EU Green Deal might not trickle down well at national and regional level but needs first and foremost a bottom-up approach, meaning exploiting a chimney rather than trickling effect".*

The need for consolidation of the EUGD in the long run was introduced, as a reality check if EU can adapt and meet the targets set. In light of that, what the EU should be doing, and it is not, is firstly to assess in detail its capacity to reach the targets, then identify the delta between the existing capacity and the set targets, and ultimately design instruments to meet the delta. General harmonisation of objectives at the EU level related to the CE implementation was considered beneficial, but with certain degree of regional freedom for attaining those objectives, based on the idiosyncratic characteristic of each region. Providing guidance, rather

than detailed instructions will be probably more constructive, and one of the roles of the CCRI is exactly picking up on that, providing to regions the *“available knowledge on research projects that have been carried out but also on funding opportunities from EU programs or also some joint undertakings that could be of interest. And it’s more about showing them the way, than giving concrete targets or templates on what to do”* (I14).

In the following sub-theme, the main challenges related to both EUGD and CE are outlined. The importance of complementarities is underlined, where *“innovation and sustainability become co-dependent on each other...but if that only happens in places like Stockholm or Copenhagen then that’s not good. Those things have got to happen in Naples or Catania or Cluj in Romania or Katowice in Poland”* (I12). Therefore, what’s crucial is *“how generic are these complementarity properties and how seriously are they taken also in the weaker places”* (I12). The question of green readiness of EU regions emerged as well, including the risk of Matthew effect where *“the first ones being even better and the last ones staying behind”* (I14). However, this is the core of the CCRI collaborative learning scheme, where the CCRI teamed up Pilots and Fellows in such a way to ensure geographical balance, as elaborated below. The existence of the Cohesion policy to counterbalance the Matthew effect was also mentioned, because *“any cumulative causation process such as development will displace such tendencies”* (I18).

Another big debate is around the economic incentives and the coercive measures, and which one will provide better results for accelerating the transition. The prevailing tendency to stipulate economic incentives is acknowledged, despite the greater efficiency of the application of coercive measures overall. This is due to the lobbyism from large companies, which are preventing the introduction of coercive measures through legislation. With the EUGD going local, is also a reality check of the related regulation to assess whether they are working or not. Due to the current sectoral approach of policy implementation, a bottleneck is being created at the regional level, and regions are facing growing challenges in addressing these changes in a productive way. The big concern is if these changes are addressed in a reactive, or a negative way, manifested by outmigration and stagnated regional performance. Another related issue is that the policy design for regulation is done without proper ex-ante territorial impact assessment, but only ex-post.

The Green Deal debate, as put forward in I16 *“is a very much a big city debate and not a regional debate”*, because aspects of place and distance are not on the EUGD radar and regions with production capacities are facing bigger challenges compared to consumption driven cities:

“Everybody wants to have clean cars, clean air, no noise but in this debate is forgotten that these cars are produced somewhere, that people have to commute from the rural side to the cities, that affordability is a crucial issue. So, all these aspects of places, of distance is not necessarily on the radar when we’re looking at the Green Deal agenda, and that is really a problem. And for the circular economy this means it’s all nice to think it in a non-productive way, like you can do a circular economy in a city easily, but when you are a chemical region and you want a circular economy of your chemical site - I give an example, in South Holland the chemical side there would need for a circular way of production the plastic it produces, the plastic it used again, it would need all plastic from Northern of Holland plus northern Germany. And then of course suddenly we discover we have suddenly a whole other dimension of circularity...”

The need to identify the underlying typology of regions among the survey and interview answers was heightened, as well as some benchmarking and assessment criteria for validating the EU divide. Lastly, the EU should assume more responsibilities for cohesive regional transitioning because it has the available tools and capacities to position itself at the same level of national governance, but probably due to historical reasons is refraining not to do so.

The question of whether the EUGD and CE can act as potential accelerator of the divide was one of the most important ones that emerged from this study. The success parameters of these policies seem to be to apply them *“at scale over long-term commitments, in the places which are not the most prosperous where the challenges are relatively greater”* (I12). In another discussion, the use of the disposable EU funds is brought up as deterministic of whether the EUGD and CE can accelerate the division, particularly the lagging behind regions (I17 – *“it’s a danger that it’s there, yeah - an accelerator of the divide. Yeah, it can be, if the regions are not using in a smart way the European funds they have, because lagging regions have a lot of European funds to do that. If they are not able to use the funds in a smart way, they are not going to make progress”*). Regarding the North vs. South divide, the Northern and Western EU MS being more advanced compared to the Southern and Eastern EU MS, one participant expressed its reservation regarding this – *“I would be a bit nuanced and saying North, South and this is what we see”* (I14). However, the same participant acknowledged the North and Central EU regions were more active during the CCRI Call for Pilots and Fellows, compared to Eastern and South EU regions. Nevertheless, in the selection stage the CCRI tried to ensure geographical balance, because the goal is to *“to push the whole of circular economy forward on within Europe actually”* and in that respect they are

looking “how to get the progress in all Member States going in that direction” (I14). Therefore, some doubts of the EUGD and CE acting as accelerator of the divide were expressed in I14 and I15, while in I18 both scenarios were reckoned as plausible:

“I think this cut both ways; it can potentially be an accelerator of the divide, especially if nothing, if business as usual continues. But there is a very real opportunity...it’s a unique window of opportunity for it to close the divide. Because it provides the right conditions for transformative innovation policies or more broad-based industrial policies that can transform regional or national economic development to take hold. And I think one of these opportunities were the Recovery Plans now, and I fear that it was not used in the best possible way across Europe, I’m not referring to any country.”

However, the distinction between the advanced (frontrunning) regions and the lagging behind (weaker) regions in the CE transition was acknowledged. This is clearly underlined in I12 where the following example was presented – *“the private sector wants to develop new technologies which are environmentally friendly, they have a market interest and a marketing interest to align themselves with very very high class and technologically advanced places like Amsterdam, Copenhagen, these places, to develop new technologies and to trial them in these locations. That makes good sense. But from European point of view the question is are they going to going to Thessaloniki?”*.

The lagging behind regions are often regions with NRBI (discussed in **section 5.3.1**), that once where the strongest industries but now they are facing the greatest environmental challenges when it comes to circular transitioning. This is the case with most of the Slovak regions, where extractive industries in the iron, steel and aluminium sectors are the core of their economy, or *“Western Macedonia and Megalopolis, where a large, a double digit at least percentage of the workforce is employed either directly or indirectly in the extraction and use of coal, or in industries that are indirectly linked with extraction, like construction and various machining industries”* (I18). In these regions where the regional strength is in NRBI, the transitioning challenge is greatest, also due to the EU commitments to phase out such unsustainable activities by 2030 (also discussed in **section 5.3.6**). The lagging behind regions have a lack of long-term vision due to the operating companies’ structure, which are just market responders, have a very short investment span and their system is geared to day-to-day management only. So, the lagging behind regions and the companies operating within the region *“often don’t have the leadership, the capacity, the knowledge...and it’s very difficult to inject it from the outside”* (I16). In order to address his major challenge, guidelines and best practices are not sufficient, because they *“can help if they reach the right people and if these right people are feeling that this is beneficial to them”*

(I16). Here the role of the EU and its institutions is twofold, promoting institutional learning for politicians for *“permanent knowledge exchange and seeing how things are been done in other regions”* but at the same time they *“need to be critical whether the system itself is designed to really produce results”* (I16).

Developed regions on the other hand, have long term vision due to the structure of the companies operating within the region, they have strong debris of big companies with long-term plans which are market shapers. In the context of the advanced regions, it was suggested that EU needs to recognise and follow the undertaken practices from advanced regions from the preparatory phases, not only once they are yielding results, as it is the case with Holland region *“because at the end we cannot wait in 10 years they will again say you know the Netherlands are so front running, we have to learn from the Netherlands. No, we are doing something now, maybe it’s time to check what we are also doing in our preparatory stage”* (I19).

The Partnership for Regional Innovation (PRI) initiative was also brought up in a couple of interviews, being one of the instruments managed by the Committee of the Regions (CoR) and the Joint Research Centre (JRC) in Seville. The PRI is *“not a funding program, so there’s no money on this, there’s no budget to fund the regions... but it is a laboratory experiment”* (I16), trying to synthesise the spirit of S3 with the sustainability process, while advancing the innovation agenda; therefore, considering growth compatible with the sustainability goal. The essence of the PRI approach was clearly outlined in I16:

“The narrative of the PRI is to get the smart specialisation to bridge out of this Cohesion ghetto, and more into the transition world with development of regional transitional strategies which engage all different policies, and not just see itself as an implementing tool for Cohesion policy. That’s the essence of our PRI approach.”

The reason why the JRC is investing in the PRI is due to its potential to *“provide a framework that is more receptive to transformation, where it is most needed, particularly in lagging territories”* (I18). The PRI can introduce new heuristic accenting sustainable development that is not based solely on regional strengths, but also on regional challenges and opportunities to be grasped thought innovation. The challenges, political capital and capacities needed to show positive results though were acknowledged. Additionally, this pilot is still in the co-creation phase and there is no legislative EU framework supporting it. Nevertheless, it might act as an inspiration for change in the current programming period and *“this might, nobody knows, influence*

legislation for what happens after 2027" (I18). An important observation is that *"there's genuine recognition of the need for more sustainable development paths"* from the regions' side, and *"this is something that regions do because they see value in it in its own"* because they perceive the PRI as an accelerator for *"tackling many of the other problems, including employment problems, including social problems"* (I18). Lastly, the potential mimetic influence emerging from the engagement in this initiative was also reflected upon.

5.3.8 Institutional pressures driving the adoption of regional CE policies

This theme has given an account on the institutional pressures influencing the adoption of CE policies within the EU regions. In that context, three types of main pressures (isomorphisms) are listed, coercive, normative, and mimetic pressures, along with their sub-categories emerging from the inductive and deductive coding. Additionally, the need to increase the influence of the normative and mimetic pressures on the adoption of regional CE policies is acknowledged.

In terms of the coercive pressures, the interviewees overall agreed with the results from the survey, particularly concerning the regulatory compliance of the international and EU legislation, therefore the interview results were expected in that regard. One of the most relevant EU legislations were certainly the EU Green Deal and the CE Action Plan, as one of its main building blocks. Generally, the EU legislation is considered as the most influential top-down driver on the national level, and in that respect the point of transposition process of EU laws into national legislation was raised. In reference to this, an interesting example was provided by the Central Denmark region which hinged on EU legislation to boost regional agenda acceptance – *"what we have been using strategically in order to raise agendas in Central Denmark Region has actually been legislation on an EU level...what we do is to try to use some of the legislation coming from the outside to raise an agenda inside our institution. For instance, also the New Green Deal we used it as a part of the way to pave a way forward on our new project and circular economy beyond waste"* (I4).

The influence of the national legislative framework on the adoption of regional CE policies was acknowledged in the case of Western Macedonia region – *"in our region, in Western Macedonia, the current circular economy policy is definitely driven by the national legislation"* (I2).

For the Region of Central Macedonia and Greek regions overall, as well as Slovakia, the development of the national S3 proved to be somewhat influential. On the other hand, the lack of external pressures from the Spanish national legislation was highlighted during the formulation of the Galician CE policy. Similarly, the Dutch government was also criticised for not taking an initiative – *“we also see that our national government is a bit hesitant to implement new national laws and regulations and are always waiting for Europe to say something”* (I13).

According to the survey results, the pertinent regional legislation had the lowest impact on the development of regional CE policies, which according to I19 – *“it should ring a bell probably to the transposition process, how the actual plan is being transposed towards regions”*. However, there were cases where relevant regional legislation has directly or indirectly influenced the regional CE policy formulation. The regional CE strategies of the Spanish regions Galicia and Catalonia, as well as Upper Austria region were impacted by their respective regional S3. Upper Austria had a wider sustainability strategy named UpperVision, as well a Road Map for the plastics value chain. Other regions influenced by pertinent sector specific strategies were South Holland with their special strategy looking into the regional logistics hubs, the Bioeconomy strategy of Catalonia and the Sustainability Strategy for Hospitals specialised in the plastic value chain in the Central Denmark region (elaborated in **section 5.3.5**). On the specifics of the Brussels Capital Region was alluded in I2, and the combination of all three levels of coercive pressures – *“don’t forget that Brussel is also at the heart of European policy makers, all the discussions at the European level, will have some influence, in Brussels as well”*.

Overall, it was suggested to replace the term coercive with legislative pressure, *“because coercive alludes to violence, it has a very specific meaning in political science at least”* (I18). Interviewees agreed on the high influence of the coercive pressures stemming from their legally binding nature, as well as their representation of a top-down approach. This can be clearly observed from the statements in I14 – *“because this is how we work in Europe – so, you have the trickle-down effect. Once we have strategies at European level it trickles down to Member State and to regions obviously, so that is how would I say, an obvious one”*. The potential adverse effects inherited in the top-down approach were already elaborated in **sections 5.3.4, 5.3.5 and 5.3.7**. Lastly, despite the current prevalence of the EU pressures, I19 emphasised that the CE transition must happen at the local level (*“on the coercive dimension, how logically it seems I also*

think it's a bit sad. Meaning that of course the EU was taken as the lead with the ambitious initiative with the Action Plan and so on, but at the end is at the local level that must happen").

The importance of all stakeholders in the regional ecosystem and their interaction was highlighted in the discussions, and some of the main questions were: *"But, the key thing is how you engage people locally? How you engage local businesses? How you can make people believe in these principles?"* (I6). In this respect the following actors were listed 1) government and public administrations; 2) industries, companies, and business agencies; 3) academia, scientific institutes, and researchers, as well as 4) society, related associations, and NGOs. Regional stakeholders were highly relevant for Central Denmark Region *"we always work with other stakeholders, without the other stakeholders we are actually nothing. So, if you want to move forward, if you want to develop a new strategy, a new action plan, we never do it without engaging and listening and involving other stakeholders, it's always alongside of them. So, it is very important for us, actually"* (I4). For the Marche region the mobilisation of the actors was also vital in many ways, as stated in I3 – *"this is also why we participate in the European projects, since the European projects facilitate this process of involving and engaging stakeholders and make them participate, and make them aware of the strategies, make them let's say an active part of the policy building process"*. For Western Macedonia the local ecosystem started to incrementally get involved in the CE transition of the region in the last years.

The significance of the society and citizens to accept the CE concept and related elements in their everyday life was one of the aims of the Slovak government, according to I11. The Marche region also acknowledged the significance of involving the society through representative associations and NGOs in related projects. On the contrary, the Galician Circular Economy Strategy for 2020-2030 was formulated without involving societal actors in the process due to time pressure, as explained in I1 – *"We failed to do that. One of the main reasons is that the regional government was hurrying us, because the regional government wants to have the document very quickly"*. The strategy was contracted by the Galician regional government and formulated by three Universities, based on their main areas of knowledge. Throughout the formulation process there was consultation with the triple helix actors via different meetings in order to get feedback from the regional government, industrial actors but also academics and research centres. Similarly, the supporting role of the business agencies, companies and scientific institutes were recognised for the UpperVision in Upper Austria region. The Central

Denmark region also proved as highly successful in mobilising the whole regional ecosystem and relevant actors, even via informal governance.

However, except regional stakeholders, higher level actors were also mentioned as playing crucial role for the regional transition – *“I think it’s the EU too as a stakeholder, so, it depends on what we define as a stakeholder, because the EU isn’t a regional stakeholder...but there are also non-regional stakeholders, who are really driving the circular economy policies”* (I8). In reference to this, various EU institutions like the European Commission, the European Council, the European Parliament, and the European Court of Auditors were brought up in the discussions.

The importance of the bottom-up initiatives represented by the action emerging from the regional ecosystem and regional actors was highlighted in I3, I7, I9, I14 and I17. The Region of Central Macedonia is relying heavily on the bottom-up actions, expecting the CE transition to be boosted by the existing SMEs in the territory. Additionally, within the Interreg projects the region was establishing local support groups representing Quadruple helix actors, as a rather informal network for sharing knowledge and best practices, with the hope to keep the actors connected after the termination of the projects – *“this is what we’re trying to do as a region - to establish links between the regional ecosystem”* (I9). The importance of performing a basic stakeholder analysis in order to identify stakeholders needs, impact and influence was emphasised in order *“to hear what stakeholders say, because they really know the regional conditions, and also, they could help to identify the strengths of the region. So, maybe even the stakeholders should be in the first place, and after the region added value and some possibilities”* (I7). Finally, during the development of the Galician Circular Economy Strategy for 2020-2030 lack of pressure from industrial associations was observed, and this was explained as following in I1 – *“they could fear that trying to develop circular economic strategy would mean more barriers, more cost, more legislation, which is a barrier to their development, for their activities”*.

Diverse range of associations, networks, organisations, or advisory bodies at various levels which played certain role in the regional transition were brought up during the interviewing phase, as listed in **Table 41**. Some of them were on a higher level, global or European initiatives, others were of a national character while there were few regional examples too. Some of them were representing a more vertical approach of collaboration like the CCRI involving both regions and cities; other more horizontal approach of collaboration like the

Danish Federation comprised of all Danish regions; while others were having multi-stakeholder approach, involving quadruple helix actors like the Cluster of Bioeconomy and Environment of Western Macedonia (CLuBE). The fostering role of these networks was particularly acknowledged in the South Holland region, where according to I13 *“that’s also the focus of our program, is the interaction and the networks regionally, where reality happens and where we’re really trying to change the world bit by bit”*. Considering the importance of these kind of CE hubs or platforms, and their growing acceptance, a whole section has been dedicated for elaboration of their role (section 5.3.9).

	Association, network, organisation, advisory body	Interview code	Context
International Level	Ellen MacArthur Foundation	I4	- Central Denmark region vouched for early inclusion of public sector in the CE transition, dominated by industrial actors
	Conference of the Parties of the UNFCCC (COP 27)	I6	
EU Level	Partnership for Regional Innovation (PRI)	I6, I12, I14, I16, I18	
	The European Committee of the Regions (CoR)	I6	
	European Economic and Social Committee (EESC)	I6	
	European Circular Economy Stakeholders Platform (ECESP)	I2, I19	
	Circular Cities and Regions Initiative (CCRI)	I9, I13, I14,	- Region of Central Macedonia part of the initiative - South Holland part of the initiative
	European Regions Research and Innovation Network (ERRIN)	I14	
	Covenant of Mayors	I2, I3	- Marche region in the process of joining
	Bio based Industries Consortium Joint Undertaking (BBI JU)	I9	- Region of Central Macedonia part of the platform
	Initiative for coal regions in transition	I18	- Western Macedonia part of the initiative
	Network of European Regions for Innovation in Agriculture, Food and Forestry (ERIAFF)	I3	- Lead by Tuscany region - Marche region is part of the network
	Nordic regions	I4	- Cooperation on projects

National Level	House of Dutch provinces in Brussels, The Netherlands	I13	- Strong regional presence in Brussels representing regional interest by doing public affairs
	Danish Federation of Regions, Denmark	I4	- Very active on climate issues - Cooperation on projects and monitoring/measuring of CE progress
	Danish Federation of Industries, Denmark	I4	- Involved by Central Denmark region in CE initiatives by informal power
	Specialised interprovincial institute, The Netherlands	I13	- Collaboration on projects
Regional Level	Circular Holland Hotspot, The Netherlands	I19	- Specific circular diplomacy group established in the European CE hub which will be leaded by Circular Holland Hotspot
	Circular Friesland, The Netherlands	I19	
	Cluster of Bioeconomy and Environment of Western Macedonia (CLuBE), Greece	I5	

Table 41: Associations, networks, organisations, advisory bodies at different levels mentioned during the interviewing phase

Awards, certifications, and available EU funding programmes in the area of CE was the last normative pressure. One interviewee alluded that this specific pressure is more influential in poorer MS and regions, compared to richer ones and suggested to see the underlying pattern of development level in the survey answers. Another interviewee raised the issue of greenwashing when it comes to sustainability awards, and the need to increase transparency of the financial reporting of companies. According to I2, the EU funding programmes “*have a big influence, really big influence on circularity in general*”, and this was corroborated also in I6, I17 as well as confirmed for Slovakia (I11) and Brussels Capital region (I2). Some of the main programmes provided by the EU were the NEXT Generation EU Plan, the Resilience Recovery Facility as well as the Operational programmes.

Available funding through EU project programmes was also acknowledged as fostering the implementation of CE policies in EU regions. The LIFE IP projects were mentioned as relevant for Marche region (I3), as well as for Central Denmark region (I4), which is a peculiar case. Before 2017 the activities in Central Denmark region were financially supported by the region itself, considering that the business development department was financed by the national Bill. Nowadays, the region is very dependent on funding from outside, therefore it is participating in many LIFE IP projects. Interreg projects played a crucial role in the

development of two key regional CE action plans in the Region of Central Macedonia (*Action plan for promotion of circular economy within the SME's and Action plan towards biobased circular economy*), and as stated in I9 *"we have those action plans that were drafted in the course of Interreg Europe projects...probably without those projects, we wouldn't have a strategy"*. Marche region is another example where the majority of the regional CE initiatives were supported by Interreg or LIFE projects – *"we as region participate to many projects, European projects, Interreg projects and LIFE projects, which has this main aim to promote and foster circular economy. And it could be interesting that in one of these projects, which was an Interreg Europe project, the Marche region has implemented an action plan which was dealing with the reuse"* (I3). What needs to be underlined within these projects is the influence of mimetic pressures, since regions from different levels of advancements towards the CE are participating therefore a lot of inter-regional cooperation and knowledge transfer is taking place, beside the funds which are tied for the implementation of the project actions.

In the context of mimetic pressures, best practices from different geographical territories were mentioned, like from advanced EU countries within different EU projects and networks. The Region of Central Macedonia was one example, as stated in I9 – *"we had the luck to have partners from North Europe, from Scandinavia for example, from Denmark, from Finland, which are very advanced in the field of circular economy. So, we had the inspiration from many good practices and from the action plans that they have implemented in the past."* The reuse centre established in the Marche region leveraged on the inter-regional cooperation enabled by EU projects to learn good practices and transfer knowledge from a city in Belgium in the waste management process. Best practices from neighbouring countries (*"we have a good example and the best practice from the other countries in our neighbourhood maybe, in Austria and Germany, in Czech Republic"*) and municipalities within the country (*"we have best practices I think also, you know within the Slovakia, in our own municipalities"*) was highlighted as having mimetic influence in the case of Slovakia (I11). The mimetic pressure exerted by leading regions was mentioned briefly in I2, but for the Marche region (I3) the initiatives from Emilia-Romagna and Tuscany region, which are also neighbouring regions, were acknowledged as being very inspirational and influential. Lastly, the importance of breakthrough projects in other provinces was brought up in the discussion with the South Holland region (I13). Regional CE policies within the country also seems to be having a mimetic role, as described in I7 – *"I'm not sure that all regions have the*

circular economy action plans, Malopolskie region where Krakow is, they have, also the Krakow city has; Śląskie region, they have as well, and I think that this is something like domino, OK. But first one has to start and after everyone will go further with this."

Overall, the influence of mimetic pressures seems to be relatively low, however, according to the discussion with the CCRI CSO (I14), in practice the mimetic influence is much stronger, particularly the influence exerted by neighbouring regions – *"in practice this is how we see a lot of the things are done"*. Namely, within European Regions Research and Innovation Network (ERRIN) and the CCRI Pilots and Fellows programme *"there is a really strong, natural tendency to seek for other regions and to have this exchange - how are you doing it? And we noticed that this is a way that a lot of the mutual learning is taking place in the first step"* (I14). So, there is a lot of informal exchange of knowledge taking place initially, and *"at a certain level they really escalate the topic of interest to the CCRI consortium"* for support (I14).

When it comes to the frontrunners in the area of CE, it seems that they were not really inspired by other regions. Galicia for instance developed their regional strategy because they were anticipating pressure following a top-down conditionality from the EU and decided to take a lead and develop the strategy on their own regional initiative. Central Denmark region is another example, that is being an inspiration for less advanced regions, but the region as such was mostly influenced by their interaction with the Ellen MacArthur foundation within the CE100 and the frontrunning cities in this context:

...where we have gained our inspiration was actually at the Ellen MacArthur foundation and very oriented persons who had a drive. For instance, we found the municipality of Malmo that had a very good demand and strategy, we found a lot of others that could give us some inspiration. But regions as such, has never been the most important inspirational part for us...As we were first movers on this agenda, we haven't looked that much to others, they have actually taking much of what we have defined and gained and taken into account in their regions." (I4)

Overall, the relative importance of the coercive pressure compared to the normative and mimetic ones was observed, where the relative influence looks much stronger for the coercive block of pressures, particularly the international and EU legislation, and it's diminishing for the following two blocks of pressures. Therefore, there is a need to shift this relative importance and increase the influence of the normative and mimetic pressures, as well as the impact of the national and pertinent regional legislation in the future, by *"building on*

collaborations...trying to link things up, so you get complementarity types of effects" (I12). The central question in that respect is – "what kind of changes might help shift that?" (I12).

5.3.9 The vital role of CE hubs (networks) in the transition

This theme focused on the role of the regional CE hubs (networks) which emerged as particularly important stakeholder and pressure, with the potential to provide real boost to the CE adoption in the EU territories. Despite existing examples in practice, like Circular Friesland or Holland Circular Hotspot, the present hubs and their activities are not recorder in the literature yet. However, related dialogues within the European Circular Economy Stakeholder Platform (ECESP) are taking place. The role of the EU in the establishment of these type of networks is vital, in terms of financial support, especially in countries with lower democratic index that are facing greater risks from political interruptions. These hubs ideally should be organised as a public-private partnership *"because many of the issues that are hindering circular economy at the local level are issues that only a private or public-private actor can solve" (I19).* Moreover, the public-private nature of the networks on one hand will ensure the political independence and perpetuity of CE-related initiatives and resources which will remain unaffected from local elections; on the other hand, they can speak with companies with the voice of privates for delicate matters in order to build trust. The potential supporting role of the regional hubs in the data collection for measuring and monitoring the CE transition was brought up, as well as the engagement of regional policymakers as representatives of the regional administrations to be actively involved in the hubs' activities. Certainly, these kinds of hubs must exist at different levels, including European and national level, but their role and function will differ. While the national ones can play bigger role in the internationalisation and CE diplomacy, the regional ones can have greater impact on the day-to-day activities of the regional actors due to the proximity.

The network will definitely need a person that will lead all activities and day-to-day business keeping in mind the transition and ensuring the *"right parties speak to each other"* and *"improve the connectivity among actors in the territory"* (I19). The term 'transition broker' has emerged as a professional figure in the middle of the Quadruple helix model that should bridge all stakeholders, especially liaising with SME's that need more capacity, support, and networking

than a multinational company needs. The functioning of the hub overall and the responsibility of the transition broker is within the *"optic of place-based transition focused approach"* (I19), encompassing the organisation of networking moments among regional actors and coordination of circular voucher instruments. The transition brokers should *"facilitate the negotiation between the company and the advisor"* (I19), safeguarding the funding provided through the vouchers are spent for the right purpose. The public governance (i.e., regional authorities) and network governance (i.e. activities of transition broker within the CE hub on the territory) should coexist and be in constant dialogue.

The last sub-theme, which is rather novel, but its prominence will increase in the imminent period indisputably is the role of internationalisation of the region, or the so-called 'circular diplomacy'. This is within the duties of the transition brokers, keeping the hub connected to the global dimension, and therefore the region itself, hence bringing the concept of think globally, act locally to the hub. Even though the academic literature is not up to date with these new concepts, initiatives have been already taken. For instance, the ECESP has already established specific CE diplomacy group which will be led by Holland Circular Hotspot.

5.3.10 Regional frameworks for measuring and monitoring CE progress

This theme focused on the regional frameworks and efforts for both measuring and monitoring the CE progress, trying to capture the distinction between the two activities. Additionally, it focused on the main difficulties pointed out by the participants for the measuring of CE transition, along with the major regional data availability issues. Several solutions to address these issues were also provided.

The vagueness of frontiers between measuring the progress of CE and monitoring the undertaken activities became evident during the interviewing process. In some instances when asked about existing efforts for measuring the progress towards the CE, participants were responding for monitoring the related projects within the region (e.g., I3, I11). Other participants expressed this verbally, like I8 (*"it depends what we understand in the measures and measurements"*) and I7 (*"I'm not sure that they called this one the monitoring framework, maybe they have proposed some kind of indicators to measure the progress"*). While third ones made a clear distinction between these two activities, underlying that measurement frameworks refer to

the intent to measure the output of the undertaken actions. This was the case with Upper Austria region – *“we have we have these road maps, and we have those different activities, and we do some kind of monitoring on the project-based level, but we do not monitor some figures, like how many materials are recycled, or the material use rate, or circular economy used and so on so...that’s a bit on a different level”* (I8). Another case was South Holland region, where they have designed monitoring system for both input (explained further down) and output, being the material flows for the province of South Holland and the material footprint attached to it, which will be published next year (I13). In this context I10 added that there needs to be a further shift of focus from emissions or outputs to major extraction materials or resources, which are mineral, non-mineral, biomass, and energy. The use of Material Flow Accounting (MFA) was suggested by I10, stating that it *“is the only way to measure the circularity”*, however, the available data is economy wide hence there are difficulties in getting disaggregated data at regional scale. Another method, which has wider availability of regional data, where sources like journal articles, as well as reports from OECD, EU, UN IRP can be potentially used, is the multi-regional input-output (MRIO) method (I10).

The regional framework of Flanders was mentioned as example by I2, stating that Belgium generally has these types of frameworks measuring circularity. In the case of Galicia, a measurement framework was developed within the regional CE policy, *“that was an imposition from the Galician government”* (I1). The specific concerns for this framework are discussed in the below sections, but overall, the included indicators were focused on environmental and economic aspects, while social aspects were somewhat omitted. From the experience of Central Denmark region, where there is internal measurement and reporting, the emphasis should be put on generally accepted measurement, like CO2 emissions, and specific activities to lower the CO2 emissions should be targeted. No other measurement frameworks were mentioned. Certain level of doubts was expressed by I2 regarding the reliability of the existing frameworks – *“I’ve seen some of these indicators at the European level, that they claim that this country is X percent circular, and I have lots of doubts about how this kind of statements can be used, to be honest in a reliable way”*.

As already mentioned, Upper Austria region was reported to be doing monitoring on the undertaken activities at project-based level (I8), as well as South Holland to be monitoring whether their transition approach is working, through stimulating break-through projects and

“monitor how many of those subsidies or projects can be supported – whether they are successful or not” (I13). Marche region was also having specific indicators for internal monitoring of the number of projects dealing with CE in the programming period. This included the number of enterprises receiving funding, the funds received in million euros and the investment deriving from these funds (I3). When asked about measurement initiatives in Slovakia, I11 referred to certain monitoring mechanisms for EU funds, both from national controls and EU audit controls, in order to monitor the appropriateness of the spent funds through different projects and operational programmes. There was lack of monitoring framework in the region of Central Macedonia (I9), while I7 wasn’t sure whether there are regional monitoring frameworks in Poland, but a national CE monitoring framework was conceptually devised within several projects, though the testing of the specific indicators will require additional time and other projects to fund it.

However, there were certain concerns which were in common for both measurement and monitoring framework, like the example of the combined framework of South Holland region which will be publicly available, setting the model for the needed transparency (I13). Both measurement and monitoring were perceived as prerequisite for informed decision making according to I3, I8, I11 and I13. Additionally, having proper monitoring mechanisms is ensuring the direction and speed of implementation for target attainment based on I1 and I2, also supported by I10, where the need for period adjustments was additionally introduced (*“you should have a proper monitoring mechanism to make sure that what you have implemented, is going in the right direction, and in the right speed so, that you would be able to achieve your goal and your target. . If not, then you need to do adjustment periodically so, monitoring mechanism is very important in the entire policy making”*).

Two examples were mentioned for wider efforts to monitor and measure the progress towards CE. Namely, the intra-country initiative of the Netherlands with the PBL, Bureau of for the living environment to develop a national monitor where all 12 Dutch provinces worked together for this initiative (I13). The strong interregional cooperation between the Danish regions was also mentioned in this context, supported by the Danish Federation of Regions, as well as some initiatives for inter-country cooperation on projects in the wider Nordic region (I4). Finally, the links between measuring and monitoring of the CE transition and the design of upcoming projects and funding opportunities was briefly introduced in I1,

arguing that a good monitoring framework will help in the design of new project in order to attain the set objectives and accelerate the transition process ultimately.

The surmounting difficulties in regional CE measurement, captured I4 - *“there’s a big desire to measure the value creation of CE and measure the impact and it’s a very difficult issue, very, very difficult”*, supported in I9, were presented in different categories below. I18 claims that CE is still too narrow trend to be measured, therefore suggesting being seen through the broader sustainability transition lens – *“if you only look at the data availability through the lens of CE, you are likely to find a lot less relevant indicators than you would if you ask a broader but related question about sustainability”*. This fact, along with the results of the survey, *“reflects to some extent to what extent the CE as a distinct concept has been recognised and has been accepted in regional authorities”* (I18).

The difficulties related to the CE measurement appear to be inherited by the ambiguity of the scope of CE overall, hence the ambiguity of the scope in measuring the CE progress. This issue, raised in I7, is very obvious in the following statements: *“Circularity is, on one hand difficult to measure, because the highest level of circularity is to refuse the use of...so how do you measure something that’s not there? So, that’s one of the things that’s really difficult”* (I13) and *“But what does it mean that, yeah? You know you can say, you can analyse if the industry is doing a strategy to improve, to reduce the waste or this these things that are not entering in the circular economy”* (I17). I2 is defining CE as *“an evolving concept”* that *“it cannot be defined by one or even five single indicators”*, therefore *“we’re not going to ever have a perfect situation that every region has all data they’re looking for such a diverse and difficult to define concept”*. I17 is adding that the existing traditional indicators are unable to capture the real impact of the CE, which is implying a transformative change (i.e. *“Yeah, we can count the amount of waste we produce, and that it’s wasted in landfills, or it’s cremated in, but this is not enough to really have a good analysis of the impact of circular economy and how companies are doing”*). This was particularly exemplified in the case of Galicia, where I1 says there are many existing industrial activities and initiatives within the umbrella of the CE, undertaken for market competitiveness or cost reduction, which are not recorded.

The caveats of baseline scenarios were underlined in I4, and the shift from backward to forward looking measurement frameworks was advised. Furthermore, the need to concentrate on measuring progress in the design phase was emphasised –

“I think that the desire of EU and also the LIFE IP that we are sitting with right now is you know, wanting to have a baseline - what is the baseline? And then the desire to follow every move you make - I think that is a waste of time, if I can say so, very frank. I think that what we need to do is to...like concentrate on how can we make our purchase and our design...you know, it's all happening in the design phase so, instead of always chasing to measure progress afterwards you should measure progress in the design phase” (I4).

According to I8 CE is tightly linked with strong commitment to business models, and the inability to capture the shift from old to new business models is causing troubles for measuring the CE, at least in the Upper Austria region. Additional issue which is hindering the measurement process has to do with the standardisation challenges (I8). In the Galician measurement framework developed within the regional CE policy, underrepresentation of measurements related to the social dimension were noted (I1).

The overall data framework indispensable to measure the CE transition appears to be absent, as reported for Western Macedonia (I5), Catalonia (I17), Galicia (I1) and Slovakia (I11). Specifically, I1 claims that regional authorities in Galicia *“are trying to hurry - what we should prioritise? where are the main progress? where we could put the money in order to progress in that data? - but they don't have a good monitoring framework so...they face some problems for that”*. The findings of CCRI are aligned with the findings from this policy Delphi study regarding the missing data framework, and furthermore, I14 argues that there are *“limited sets of indicators, but they are looking at a particular element of one of the fields within CE as a whole”*, hence, there is a current lack of an integrated measurement framework at the regional level. I17 is adding that there is a need for new metrics to evaluate transformative processes, like the transition towards CE model *“and this is a challenge in all regions, and in Europe, and in the world”*. According to I11, the Slovakian ministry is taking steps to address this issue, as there is an intention to devise data framework within the current RIS3 for Slovakia, as well as within the Action Plan of Smart City for 2023-2026.

Fragmented and uncoordinated efforts were another big challenge which was reported on several occasions, for data collection but also for data processing. This was generally stated in I3, and specifically mentioned for the region of Western Macedonia (I5), South Holland (I13),

Central Macedonia region (I9), Slovakia (I11) as one of the main obstacles encountered, which according to I7 *“it’s the biggest challenge in the monitoring framework testing and implementation”*. Last but not least, the ability and capacity of regional authorities to develop policy intelligence for developing indicators, making an informed use of the developed indicators and evidence-based policymaking, is generally lower compared to the capacity of the national authorities (I18).

The regional data availability issue was one of the main obstacles which was underlined in many of the discussions (I2, I3, I7, I9, I13, I17, I19), faced by several regions as elaborated below. But, according to I2, even the national level is struggling to ensure data required to build a reliable monitoring framework, therefore it is somewhat expected that this issue is even more present at the regional level *“which can get even more complex getting data and having an overall picture of what’s the situation”*. The available data at the regional level is mostly focusing on waste and related areas (I1, I4, I7, I14, I17) and according to I13 *“the best data we have actually is the waste data”*, because as explained in I14 waste is a regional competence in a lot of MS. Moreover, the fast versus the slow-moving loops were presented, and the difficulties in measuring the circularity of the slow loops. The building industry with the building waste data was used as an example, where as described in I13 *“we measure the circularity of 50 years ago not the circularity of today”*, implying the historical nature of the data *“because when you are using measurements, you’re always addressing yesterday’s facts and figures”* (I4).

The lack of data on the specific regional scale was another barrier which was encountered in two distinct scenarios. The existence of national data that needs to be disaggregated at the regional level was described in the case of Galicia (i.e., *“most of the data is very general data with some disaggregation”*, I1) and South Holland region (i.e. *“instance national data we have to break it out into the provinces, and things like that - that’s kind of difficult”*, I13). While in the region of Western Macedonia an inverse scenario is happening, where there is municipal data which needs to be aggregated at the regional level (i.e. *“at least in our region, at local level, at municipal level there are data...you can find data from various streams, so all what you have to do at the regional level would be just to collect the existing data...even if it’s scarce, but at least you would have some data. But that doesn’t even happen”*, I5). The broader capacities and resources issue emerging from the centralised statistical systems were also mentioned in this respect by I18.

The metrics in the monitoring framework developed along with the Galician CE strategy were very specific according to I1, making it very hard to develop and sustain the input needed to assess the progress. The Galician regional government insisted on including particular metric for each of the proposals and actions within the CE strategy, and they had over 60, while the involved academics were advising for more general metrics. The lack of detailed data was also mentioned in I19. The reluctance of companies to supply financial data to the statistical offices was an obstacle faced in the region of Central Macedonia (i.e. *"sometimes even the companies, they don't want to give data...because when it is financial data, they think that this data could be used to sort of control reasons"*, I9) and Poland (i.e. *"if companies will have to report something, they will do it, but if they don't have to, they will not do it at all, because it's additional work for them"*, I7), and it was also supported by I1 (i.e. *"nowadays, firms and industry they have to answer to many surveys for a lot of objectives for regional governments, for national and regional statistics offices"*).

Additionally, the data reliability and data quality concern were introduced in I17 and elaborated in I4 (i.e., *"we are emphasising data much too much and the data delivered are not on a quality and cannot be on a quality"*), suggesting that the EU funding on projects is based on unreliable data (i.e. *"we have to write some figures because if we don't, we won't get the money. But it's like, we haven't got anything in the world that can tell us how to figure out what to write, in order to be frank, and I think that the EU funding system is like, is basing some of the data on figures that are not really based on anything that you can trust, in order to be frank"*, I4). The lack of innovative approaches being adopted when it comes to data was emphasised in I19 (i.e. *"when I speak with regions they are still working on a very old data basis, very classical approaches on how to generate monitoring or views or indicators or whatever to understand the situation"*), while I17 brought up the issue of the laggard feature of statistics overall (*"in a world that is changing so fast, statistics are very slow to change. That's the problem"*).

Finally, some courses of actions and potential initiatives were proposed in order to address the issue of regional data availability, measurement and monitoring of the regional progress towards CE. The involvement of academic actors and research institutes in both data collection (I3 and I19) and developing measurement frameworks (I3, I8 and I19) was suggested. Another recommendation by I7, I13 and I17 was to leverage on regulatory

compliance, national or regional laws, to induce data collection from industry, and the corporate sustainability reports were mentioned as a new dataset that might be of use (I13).

The idea of the EU to provide some sort of general guidance, a non-binding document, on how to develop a regional data framework or apply the existing EU CE monitoring framework on the regional level was considered as useful by I2. According to I14 this is *“one of the concrete things that CCRI could be very supportive to the cities and the regions, and it’s also being picked up”*. I1 also supported that idea, in order to have a harmonised framework which will enable comparison between regions, by setting a common ground at EU level, *“because otherwise you could find countries saying we are recycling quite a lot, we are leading recycling in Europe and when we try to look to the data and get some information from external sources, what you find is that most of the recycling is just burning in order to produce energy and that is not recycling”*. On the other hand, the risk of adverse impact has been raised by I3 and I13, claiming that this might be perceived by regions as an extra layer of boreoarctic obligations. The development of certain frameworks and indicators within interregional EU projects was given as an example, Interreg project mentioned by I14 and Horizon project mentioned by I19. And in the case of Galicia, I1 developed and presented a related regional project to the regional government of Galicia.

The potential role of circular hubs as public-private network for data collection was underlined in I19, as well as the need to utilise innovative approaches and available advanced technologies for data collection and generation (i.e., *“I mean we are living in 2023 where we are speaking everyday about ChatGPT and all these kind of things that are generating a lot of information starting from a small amount of data”*). Namely, to leverage on the twin transition particularly was emphasised - *“digitalisation and CE we always say they should go hand by hand, this is one dimension where they’re not going hand by hand yet”* (I19). I2 is advising regions to initially identify areas with existing data where they can show some elements of progress and leverage on that, and then through cooperation with the national level try to develop other indicators or refine the national ones to fit the regional needs. However, it is vital to ensure sequence and perpetuity between political cycles, in order not to redevelop everything from the beginning. But most importantly, realistic targets should be set which could be attained. Lastly, I18 mentioned several attempts to regionalise broader sustainability indicators, including the JRC resilience dashboard.

5.4 Policy Brief distribution – analysis and discussion of results

The developed policy Delphi study followed a very rigorous procedure, which culminated in the last stage where the Policy Brief was validated in order to close the round of iterations with the policy experts. As already mentioned in **section 4.7.3**, the distributed Policy Brief contained seven main groups of policy implications, which were emerging from the initially devised conceptual framework. These included 1) the regional narrative in the CE transition, 2) the institutional pressures driving the CE policy formulation and adoption, 3) the process of formulation and implementation of CE policies, 4) the nexus between S3 and CE, 5) the role of regional CE hubs, 6) the PRI initiative and 7) the process of tracking the regional performance.

In total 10 experts provided feedback, out of which 9 by email and 1 by brief online discussion, which was subsequently transcribed. The full list of experts which participated in this last stage of the policy Delphi study is available in **Appendix C**. The feedback was gathered in one file for analysis, and considered further for developing the validated version of the Policy Brief, included in **Appendix J**. Moreover, the comments were taken into regard for the finalisation of the conceptual framework, the emerging findings and policy implications of the empirical study overall. All participants corroborated the presented policy implications in the Policy Brief and expressed their interest in reading the published research outcomes of the study. One participant provided editing changes to the Policy Brief along with some phrasing comments, another one asked for clarification on the regional CE hubs, while two participants proposed including the research context in the Brief, like which were the participating regions in the study. Nevertheless, since this Policy Brief is part of the report where detailed information regarding the participating experts and regions is already included, this suggestion wasn't taken on board.

5.5 Conceptual framework – discussion

The emerging findings from the policy Delphi study are presented graphically in two conceptual frameworks, the simple version shown in **Figure 56** and the more complex version illustrated in **Figure 57**, which was initially devised from the survey (*Phase 2*) and individual interviews (*Phase 3*) and was validated through the last stage of Policy Brief distribution (*Phase 4*). The starting point for the development of the final conceptual framework was the theoretical framework developed in **chapter 4 (section 4.4.2, Figure 40)**, where institutional theory was used as the theoretical lens for the study. Namely, the role of institutional pressures, coercive, normative, and mimetic, in the diffusion and adoption of regional CE policies was investigated. A particular attention was given to the S3, treated as a type of a normative institutional pressure, and whether they act as a driving force for the transition towards a regional CE adoption, or in contrary they even obstruct the transition of a region in their green transition. Ultimately, an attempt was made to identify the impact (economic, social, and environmental) that the S3, along with the remaining normative, but also coercive and mimetic institutional pressures have on the adoption of the regional CE policies.

The evolution and enrichment of the theoretical framework into the final conceptual framework is evident, adding more complexities and additional factors to be considered. It is built from seven building blocks, out of which the main ones remain the same: the different types of institutional pressures which are influencing the formulation and implementation of regional CE policies, which in turn influence the regional performance in social, environmental, and economic aspects. However, the institutional pressures and the process of developing and adopting CE policies are very distinctive in each region, considering the local factors, hence the regional narrative in which the transition takes places is different and it's a vital precondition which must be taken into account. The S3 are influencing the formulation and adoption of the CE policies, but also are being influenced by the CE policies – hence, a mutual relationship exists. However, the S3 and CE nexus proved to be less deterministic, as concerns regarding the potential risk of regional lock-ins and path dependency issues were also raised. The role of the regional CE hubs or networks, as part of the normative pressures group, led by transition brokers is emerging as very influential, having an accelerating impact on the transition process of the region where it exists. Last but not least, the PRI as new EU instrument is quite promising risk mitigation mechanism to

address the potential risks inherited in the S3 heuristic, therefore, having the opportunity to positively impact the development of regional CE policies. Each of these blocks are elaborated in detail in the following sections, linking them particularly with the dense results from the semi-structured interviews conducted with the policy experts.

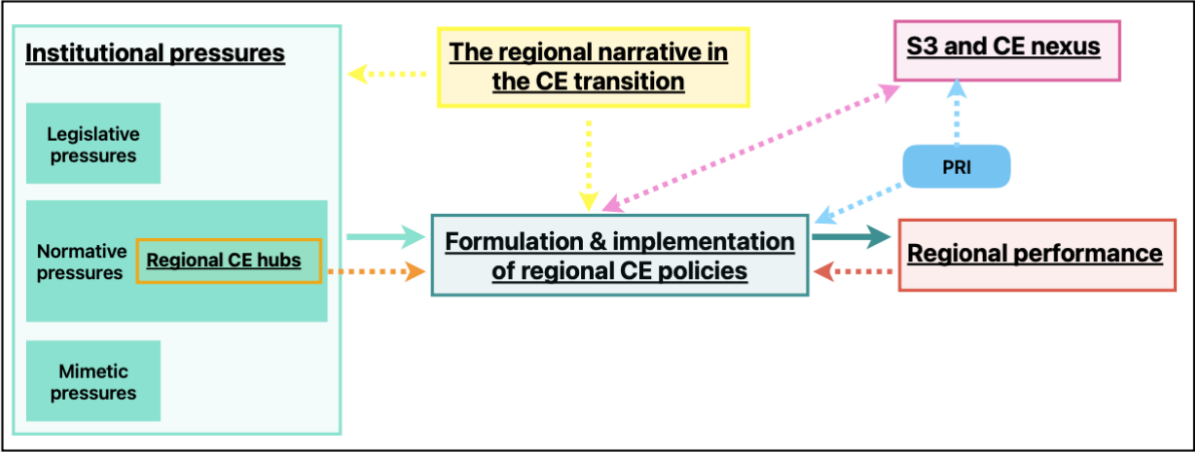


Figure 56: Conceptual framework developed from the policy Delphi study (simple version)

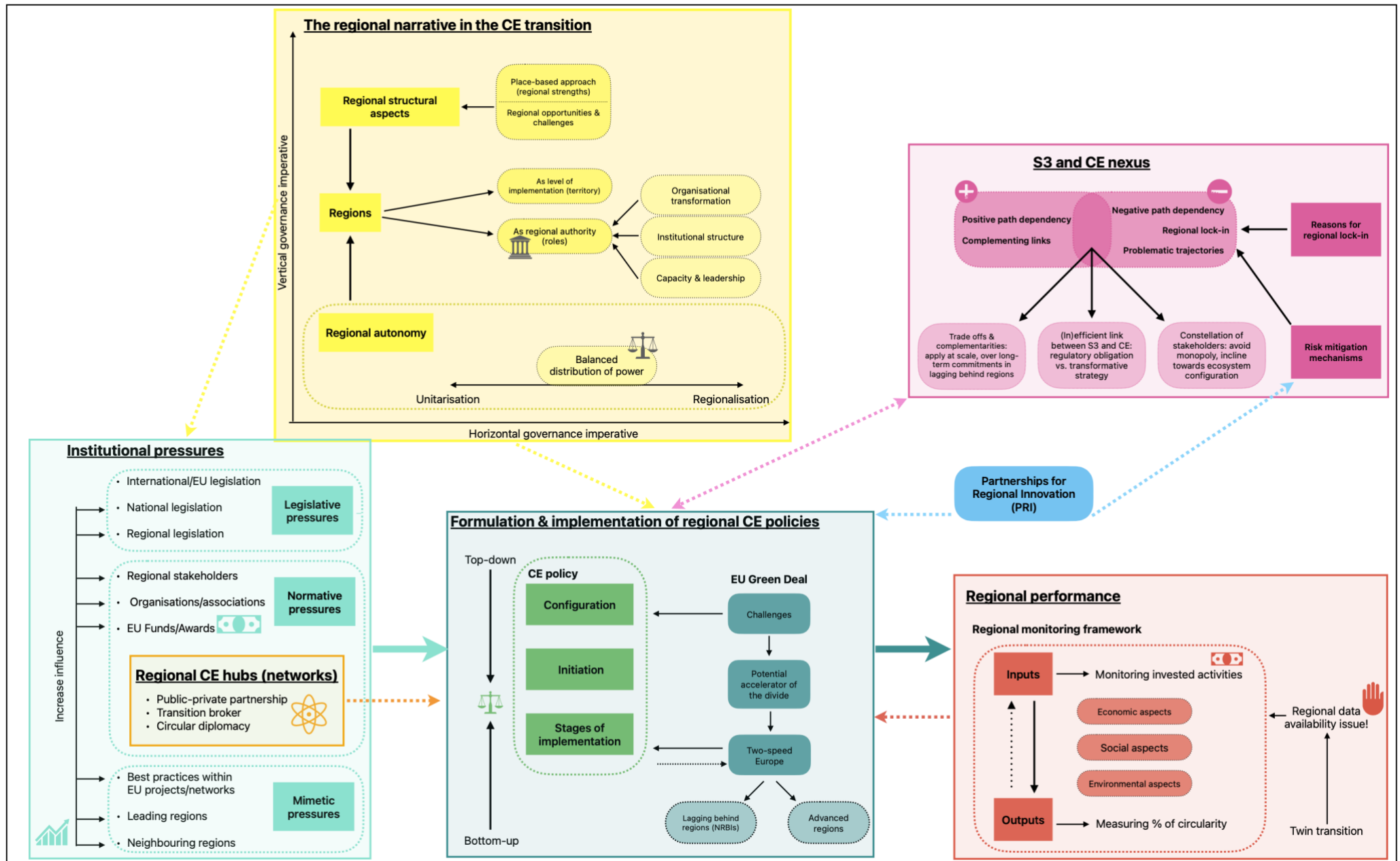


Figure 57: Conceptual framework developed from the policy Delphi study (complex version)

5.5.1 *The regional narrative in the CE transition*

Meticulous analysis of the **regional narrative** is the starting point for transitioning towards CE, as **each region will transition in a territorially differentiated manner** (section 5.3.1), as also claimed in Arsova et al. (2021). Therefore, this is the first building block of the conceptual framework (**Figure 57**), influencing both the institutional pressures within the region but also the formulation and implementation of the regional CE policies. Hence, careful consideration of the **regional structural aspects is indisputably a precondition**, entailing on one hand the **place-based approach anchored on regional strengths**, but **simultaneously considering the challenges** the region is facing along with the **emerging opportunities** on which the region can leverage on. Equally important are the **regional dynamics characterised by different idiosyncratic factors** including geographical, economic, social, environmental, political, cultural, and technological factors, along with the **industrial structure of the region**, particularly in the **regions with natural resource-based industries (NRBIs)**.

The role and importance of regions was overall recognised throughout the whole policy Delphi study, and it was perceived through two different viewpoints – considering the **territorial level of policy implementation** and the perspective of a **regional authority**. When it comes to the latter, a **tendency for organisational transformation at the level of regional administration was observed, shifting the focus towards challenges and transitioning themes** in order to better align the organisational structures with the goals of the CE transition (section 5.3.2). In that context, **regional efforts for establishing a transversal coordination unit extending beyond departmental borders** could be beneficial, therefore adopting a **holistic and systemic approach** in the traditional departments at the public institutions (section 5.3.3). This is in line with the findings from Henrysson and Nuur (2021), where they highlighted the need for policy interventions, beyond sectoral involvements and called for policy actions directed towards local factors being crucial for establishing and maintaining institutional environment supportive of CE-based transformations.

The **institutional structure and overall prevailing mentality in regional authorities** proved to be vital for the development and adoption of CE policies, because **collaboration and trust required to undertake CE initiatives are fostered locally** (section 5.3.3). Another essential issue to be addressed is to **ensure perpetuity between political cycles**, especially at the local

and regional elections. The importance of having **well developed capacity and leadership skills at the regional level to envisage long-term vision and actions** was also stressed, which makes regional authorities to feel agency over their own future. However, the lack of regional capacities to plan, design and execute CE strategies was noted, as well as the **uneven availability and distribution of skilled public servants** in regional authorities working on the CE transition. An investment in human capital and tools needs to be made in order to address the lack of capacities in regional administrations. Available instruments within the Cohesion funding were mentioned in this respect, and the peculiar fact that many of those regions that need it the most are not taking advantage of them (**section 5.3.3**).

Regional autonomy is another important determinant, which is being reflected in a rather **fragmented legislative landscape within the EU**, as extensively explained in **section 5.3.2**. Namely, based on the **division of power the EU regions are split into regionalised Member States (MS) and unitary MS** at the two sides of the spectrum. In the regionalised MS the sub-national level, i.e., regions, have legislative powers, therefore **a statutory delegation of power** is exercised by the central government, i.e. **devolution**. Regions are having **regional autonomy to devise regional laws** in certain sectors and therefore have wider range of instruments disposable to mobilise regional stakeholders and initiate change. Simultaneously, this is one of the main challenges and caveats of regionalised governments, because it can **often instigate a gridlock between the central and regional government**. In unitary MS, the legislative power is entirely concentrated at the central government level, resulting in **lack of regional autonomy, limited planning capabilities** of the regions within these MS and general **difficulties to advance centrally devised strategies**.

Balanced distribution of power between formal and informal regional players was therefore deemed as ideal, ensuring **harmonious symbiosis between central government and local level**. In these instances, regions are playing an important role in the design and implementation of the policies, hence *“it’s not a race against the government, it’s actually a positive action for and with the government”*. These regions despite the lack of legislative power to devise regional laws are one of leading regions in the transition towards the CE, due to their strong institutional capacities, informal governance, organisation culture and value of regional authority being aligned with environmental affairs.

In that respect, the need of having a **unified narrative towards the CE transition** through the existence of a **functional and efficient multi-level governance mechanism**, including **vertical and horizontal governance imperative**, as argued in **section 5.3.3**. The vertical governance imperative emerged as highly important for the CE transition and in this respect the balanced distribution of power played a dominant role. The **issue of coordination transpired** in this discussion, where opposing views were noted. Some regions focused on ensuring directionality and transformative action, rather than coordination, while for others the lack of coordination was underlined as the main impediment to advance towards a more circular future, by decelerating the transition process and increasing the complexities. Hence, the establishment of some type of coordination body was deemed indispensable, and this need can be utterly met with the establishment of regional and national CE hubs (see **sections 5.3.9 and 5.5.2.1**). At the EU level, the formation of the CCRI CSO (Coordination and Support Office) was envisaged to tackle the coordination issue in order to overcome the challenges for CE transition. The horizontal governance imperative among different regional authorities and provinces was also stressed as instrumental for the CE transition in several interviews. In this setting, *“the regional level is so efficient, as the particular regional governance is developed”*. Lastly, in the CE transition it is fundamental that the **interplay between all governance levels is maximised**. In this context the EU plays a central role, by pushing for collaborative learning and bringing all relevant stakeholders together for knowledge exchange.

5.5.2 Institutional pressures driving the regional CE policy formulation and implementation

The three groups of institutional pressures were one of the main building blocks of the theoretical framework (**section 4.4.2, Figure 40**), and remained one of the main blocks in the conceptual framework (**Figure 57**). Additionally, considering that RQ2 (**section 4.2**) was dedicated to investigating the pressures which are influencing the adoption of CE policies within EU regions, the related findings are one of the most vital ones from the empirical study overall.

The influence of legislative, normative, and mimetic pressures on the formulation and adoption of regional CE policies was investigated both during the survey phase (**section 5.2.4**) and the interviewing phase (**section 5.3.8**). In terms of the legislative pressures, referred to as

coercive pressures in the survey, the interviewees overall agreed with the results from the survey. The **legally binding nature of the international and EU legislation was justifying the predominance of this pressure in the legislative group of pressures**, followed by national legislation, representing a **top-down approach of policy development and a ‘trickle-down effect’**. In light of this, the potential adverse effects inherited in the top-down approach were mentioned in **sections 5.3.4, 5.3.5 and 5.3.7**.

The **low influence of the pertinent regional legislation** (e.g., S3, wider sustainability agendas, climate mitigation plans) **was stressed as an issue, which should ring a bell to the transposition process, since the CE transition ultimately is a local case scenario – it must happen at the local level**. However, the implications of these results need to be interpreted with caution, considering the **fragmented legislative EU landscape where the issue of devolution emerges** (elaborated in **section 5.3.2**). Namely, regions with regional autonomy to devise regional laws might be in a better position to leverage on the existing regional legislation to advance the CE transition, compared to regions which are part of a unitary MS where the national government is the supreme authority.

The **regional stakeholders representing the regional eco-system**, the Quadruple helix actors, was the predominant driver not only on the normative side, but overall, from all pressures. This indicates a **bottom-up approach, or the desired ‘chimney effect’**, contributing to more interaction between the top-down and bottom-up initiatives (**section 5.3.7**). The **challenge of underrepresentation of the societal actors** in the policy formulation process was raised, along with the **importance of higher-level actors, like EU institutions**, which are also playing a crucial role for the regional transition. The inclination towards a more ecosystem configuration of the stakeholders, and avoiding a monopolistic situation dominated by key industrial players was also stressed in **section 5.3.6 and 5.5.4**.

A diverse range of associations, networks, organisations, or advisory bodies at various levels which played certain role in the regional transition were recorded in **Table 41 (section 5.3.8)** and considering the increasing importance of these kind of CE hubs or networks and their growing acceptance (**section 5.3.9**), they have been introduced as a separate normative pressure in the conceptual framework, elaborated in **section 5.5.2.1**.

Available funding through EU project programmes was also acknowledged as fostering the development and implementation of CE policies in EU regions, a **pressure which appear to be more influential in poorer Member States (MS) and regions, compared to richer territories**. In this context, a discrepancy between regions is observed also when it comes to the S3 importance, since it relies heavily on EU funding flows. Namely, in wealthier regions S3 is only one of the many strategies available to promote transition, but economically weaker regions depend fully on structural funds, as already mentioned in **section 5.3.6**. Therefore, it is crucial to see these institutional differences in the bigger picture, in order to avoid having erroneous and generic conclusions. Additional analysis needs to be made to identify potential patterns, and uncover these differences tied to the division of power of the specific MS and the role and importance of the structural funds within the MS (issues mentioned in **sections 5.3.1 and 5.3.2**).

In terms of mimetic pressures, **the exchange of best practices within EU projects and networks seems to be important**, where a lot of **inter-regional cooperation and knowledge transfer** is taking place, beside the funds which are tied for the implementation of the project actions. Additionally, mimetic pressure coming from **leading regions in the area of CE and neighbouring regions are mentioned**, and while the survey results are showing a rather low influence of mimetic pressures, in practice they appear to be much stronger, particularly the influence exerted by neighbouring regions but also by frontrunners. When it comes to the frontrunners in the area of CE, it seems that they were not really inspired by other regions, but rather global initiatives, leading cities and anticipating pressure following a top-down conditionality from the EU.

A similar regional case study was done by Alonso-Almeida and Rodríguez-Antón (2020), where the findings showed coercive pressures followed by mimetic as being most effective ones for advancing the CE in the Spanish regions, while normative pressures were not so relevant, which is contradicting the findings of the current policy Delphi study.

Overall, there is a **need to shift the relative importance of normative and mimetic pressures in the future**, as well as increase the influence of national and regional legislation (keeping in mind the fragmented legislative EU landscape). The central question in that respect is – “what kind of changes might help shift that?”

5.5.2.1 Regional CE hubs (networks)

The existence of the so-called **regional CE hubs** or **networks** are another determinant, categorised as a type of a normative isomorphism which can boost the CE adoption in the EU territories. Despite existing successful examples in practice, like Circular Friesland or Holland Circular Hotspot, the present hubs and their activities are not recorder in the literature yet. Nevertheless, Arsova et al. (2021) identified the need for establishing such living constellation of regional stakeholders and proposed the CE-centric quintuple helix model, which promotes the emergence of such networks. Bezama et al. (2019) also pointed to the necessity of **regional clusters and networks**, where all relevant actors will be integrated and will then serve as **platforms for discussion and knowledge exchange**

These hubs, as introduced in **section 5.3.9**, ideally should be **organised as a private-public partnership** because the main challenges which are hindering CE at the local level can be addressed only by a private-public actor. Furthermore, the public-private nature of the networks on one hand will **ensure the political independence and perpetuity of CE-related initiatives and resources which will remain unaffected from local elections**; on the other hand, **they can speak with companies with the voice of privates for delicate matters in order to build trust**.

The **transition broker** is the professional figure **leading all day-to-day activities of the hub, while keeping in mind the transition and improving connectivity among actors in the territory**. Hence, the transition broker is in the middle of the Quadruple helix model, bridging all stakeholders and particularly liaising with SME's which are in need of capacity, support, and networking opportunities. The **public governance** (i.e., regional authorities) and **network governance** (i.e. activities of transition broker within the CE hub on the territory) **should coexist and be in constant dialogue**.

An interrelated concept which is gaining an increasing prominence, and which is in the realm of the hub and the transition brokers, is the one of **internationalisation of the region**, or the so-called '**circular diplomacy**', implying keeping the hub connected to the global dimension, and therefore the region itself, hence bringing the concept of think globally, act locally to the hub.

These types of networks should be **established on higher levels** as well, like **EU and national**, with different roles and functions; while the national ones can play bigger role in the internationalisation and CE diplomacy, the regional ones can have greater impact on the day-to-day activities of the regional actors due to the proximity.

The need for such a network to accelerate and coordinate the CE transition at the regional level was also directly and indirectly raised in other sections. The discussion around the constellation model of stakeholders which can support best the CE advancement of EU regions also implied the need for an inclination towards a more ecosystem configuration, while warning about the detrimental effects of having a monopolistic situation where key industrial players are dominating the transition (**section 5.3.6** and **section 5.5.4**). Overall, the importance of all Quadruple helix stakeholders in the regional ecosystem and their interaction was highlighted as one of the most significant normative pressure in **section 5.3.8**, also synthesised in **section 5.5.2**. More specifically, a diverse range of associations, networks, organisations, or advisory bodies at various levels which played certain role in the regional transition were listed in **Table 41 (section 5.3.8)**, among which were existing regional CE hubs which had a multi-stakeholder approach, like the Cluster of Bioeconomy and Environment of Western Macedonia (CLuBE). The importance of these networks was raised even in the survey stage, as an additional comment provided by one expert from South Holland. Namely, a point was made that these networks is where EU regions are collaborating and influencing each other positively, resulting in shared viewpoints that regions can offer to the EC with lobby and position paper, creating a bottom-up policy development (**section 5.2.4**).

5.5.3 Formulation and implementation of regional CE policies

The formulation and consequent implementation of the regional CE policies is the central building block of the conceptual framework, influenced by all remaining blocks. Some essential determinants which need to be considered during the formulation of regional CE policies emerged, including the **need for system boundaries delineation**, the **local ownership of the CE agenda** and the acknowledgement that **there is no “one-size-fits-all” solution**, but the regional and local narratives are playing a determining role in each region. Last determinant to be considered, particularly for the national level is to provide overall

framework where regional authorities can innovate based on their local situation and trying to strike the balance between compliance and “room” for innovation, a recommendation emerging also from the study of Sutcliffe and Ortega Alvarado (2021).

The **configuration of the CE policies at the regional level was also categorised, representing wide range of scenarios**. Namely, some regions didn’t have a CE policy and didn’t have the intention of devising one, some had standalone CE policy, while in some regions the CE agenda was part of a wider sustainability agenda or S3 strategies (**section 5.3.5**).

The **initiation of the CE policies and related activities** in the investigated regions was also explored, and the respective scenarios presented in **section 5.3.5**. Factors like **provincial elections with CE political agenda** and **shift of organisational structures and modus operandi** in the regional administration were the motivators behind the policy formulation in some instances. There were cases where the policy development was a **result of a regional initiative**, coordinated and contracted by the regional government; and cases where a **co-creation approach was followed**, founded on normative and innovative approaches to mobilise the regional ecosystem, due to the **genuine interest in the CE agenda of regional authorities**. Considering the legal obligation of formulating National and Regional Waste Management Plans (WMP), some regions literally **converted their WMP in CE plans**, which were focused on waste management mostly. In other occasions, certain regional policies were **formulated following a top-down conditionality**, either coming from the EU or national governments. The Galician case, as presented in **section 5.3.5**, was an example where the EU policies and priorities were more influential than the national ones, pointing out to a **potential disjuncture of the transposition process**. Nevertheless, the **impediments for these EU initiatives reaching all regions simultaneously** were also highlighted since this will **require a particular governance structure** and more focused approach targeting specific areas. Finally, in some cases despite the lack of regional CE policy, scattered CE related activities were undertaken within different EU projects.

Lastly, the different **stages of CE policy implementation** among regions were presented, along with some of the main challenges regions are encountering. On one side of the spectrum there were very advanced regions where the **CE policy has already penetrated in a wide range of existing regional policies**, and there is an integration of the CE concept, while on the

other side there were regions which literally **didn't know where to start from**. In between these two extremities, different cases were recorded. For instance, some regions were **in the process of formulating regional CE policies** or had **different scattered CE initiatives**. Overall, the CE concept started penetrating in related policies and discussions at the regional level, however there is still a **time lag between West and North Europe, compared to South and East Europe**. In other regions **lack of realisation** was observed due to different reasons, like the **immaturity of the CE concept, difficulties in the CE implementation on the industry side, policy prioritisation issue and lack of regional enforcement mechanisms**. Generally, a lack of CE realisation on the EU level was observed; where the required technology is available, but the market is not adapting and purchasing it to enable higher circularity rate.

CEAP, as one of the main building blocks of the EUGD, was discussed in **section 5.3.7**, where the **accent needs to be put on the implementation**. Both the EUGD and the CEAP are **formulated and implemented following a very top-down approach**, which certainly has the advantage of providing a unified directionality. The very top-down approach has the tendency to be auspicious for the already advanced regions, neglecting the needs of the weaker ones. Additionally, **the increased environmental top-down conditionalities related to the EUGD funding instruments are rising the risk of squeezing out innovation** due to additional web of requirements, leaving regions with fewer degrees of thinking freedom. But **without the bottom-up approach a lot of conflicts and frustrations are generated**; hence we need a **more balanced interventions** and ways to **increase the interaction between both approaches**. These findings are in line with several studies, where **the need for a balanced approach to implementation** was also acknowledged along with the equal commitment of all stakeholders (Sánchez Levoso et al., 2020; Vanhamäki et al., 2020; Aranda-Usón et al., 2018). The possibility of the EUGD not trickling down well at national and regional level was expressed, emphasising **the need for exploiting a “chimney” rather than “trickling effect”**. These findings, discussed also in **section 5.3.4**, emerged initially from the Survey results (**section 5.2.4** and **5.2.5**), which were corroborated during the interviews (**section 5.3.7**). Moreover, a third approach, not recorded in the academic literature so far, was introduced - the **side-way in approach**, combining benchmarking and leapfrogging, therefore relying on mimetic pressures (**section 5.3.4**).

The **need for consolidating the EUGD in the long run** was introduced, as a reality check if EU can adapt and meet the set targets. In light of that, what the EU should be doing, and it is not, is firstly to assess in detail its capacity to reach the targets, then identify the delta between the existing capacity and the set targets, and finally design instruments to meet the delta. **General harmonisation of objectives at the EU level** related to the CE implementation was considered beneficial, but **with certain degree of regional freedom** for attaining those objectives, based on the idiosyncratic characteristic of each region. **Providing guidance, rather than detailed instructions** will be probably more constructive, and one of the roles of the CCRI is exactly picking up on that.

Some of the **main challenges related to both EUGD and CE** were outlined, including the **importance of complementarities** (section 5.3.6 and 5.5.4) and the **risk of Matthew effect**. Another big debate is **economic incentives versus coercive measures**, and which one will provide better results for accelerating the transition. The **prevailing tendency to stipulate economic incentives** is acknowledged, despite the **greater efficiency of the application of coercive measures** overall. This is due to the **lobbyism from large companies**, which are preventing the introduction of coercive measures through legislation. With the **EUGD going local**, is also a reality check of the related regulation to assess whether they are working or not. Due to the **current sectoral approach of policy implementation, a bottleneck is being created at the regional level**, and regions are facing growing challenges in addressing these changes in a productive way. **The big concern is if these changes are addressed in a reactive, or a negative way**, manifested by outmigration and stagnated regional performance. Another related issue is that the **policy design for regulation is done without proper ex-ante territorial impact assessment**, but only ex-post. Furthermore, the **Green Deal debate was characterised as “a big city debate and not a regional debate”**, because **aspects of place and distance are not on the EUGD radar** and regions with production capacities are facing bigger challenges compared to consumption driven cities. The need to identify the underlying typology of regions among the survey and interview answers was heightened, as well as some benchmarking and assessment criteria for validating the EU divide, developed by the OECD and the JRC.

The question of whether the **EUGD and CE can act as potential accelerator of the divide** was one of the most important ones that emerged from this study, which was also the central

question in Arsova et al. (2021a). The **success parameters of these policies** seem to be to apply them *“at scale over long-term commitments, in the places which are not the most prosperous where the challenges are relatively greater”*. In another discussion, the use of the **disposal EU funds is brought up as deterministic** of whether the EUGD and CE can accelerate the division, particularly if the lagging behind regions are not using the EU funds in a smart way. However, there were **doubts expressed** as well, where a **unique window of opportunity was noted to close the divide**, *“because it provides the right conditions for transformative innovation policies or more broad-based industrial policies that can transform regional or national economic development to take hold”*.

Nevertheless, the **risk of two-speed Europe was identified and the gap between the advanced (frontrunning) regions and the lagging behind (weaker) regions in the CE transition was acknowledged**. The lagging behind regions are often regions with NRBI (discussed in **section 5.3.1**), that once where the strongest industries but now they are **facing the greatest environmental challenges** and the transitioning is hindered even more by the **EU commitments to phase out such unsustainable activities by 2030** (also discussed in **section 5.3.6 and 5.5.4**). The challenges related to the NRBI were also identified by Henrysson and Nuur (2021), demarcated by path-dependencies and lock-ins in conventional technologies, infrastructures, and production approaches, making the transition perplexing. The lagging behind regions have a lack of long-term vision due to the operating companies' structure, which are just market responders, have a very short investment span and their system is geared to day-to-day management only. So, **the leadership and capacity needed is very difficult to be injected from the outside**. While **advanced regions**, have long term vision due to the structure of the companies operating within the region, they have strong debris of big companies with long-term plans which are market shapers. The underlying trend towards economic divergence across the EU in the twin transition was also revealed in the study by Maucorps et al. (2022), with the digital and green transition amplifying these trends between high-income and low-income regions.

5.5.4. S3 and CE nexus

The significance of the S3 as a fundamental delivery mechanism for the EU's new sustainability agenda as proposed by Larosse et al. (2020) and as the most holistic instrument for implementing CE at the regional level according to Compagnoni (2020), supported also by Arsova et al (2021), was corroborated in this empirical study, because S3 emerged as another significant variable influencing the development and adoption of the regional CE policies. Namely, **a mutual interaction between the two policies was uncovered** by the majority of the participants (**section 5.3.6**), validating the survey findings (**section 5.2.2**). A constant interplay between the two strategies was defined, and this is becoming more widespread lately, due to increased awareness of the CE idea. Moreover, an overlap between the two concepts was noted, having some of the main principles of S3 being at the heart of CE, combined with evolution of ideas across the two strategies simply because the involvement of the same people working on both strategies. These potential synergies between S3 and CE were also identified by Vanhamaki et al. (2021).

However, an important distinction was made concerning the indispensability between the two policies. Namely, **the CE approach doesn't necessary imply a S3, while the priority of the S3 should be to embody the CE** as way of thinking, building up a strategy based on green, inclusive, and smart complementarities. In fact, these are the foundations of the new generation of S3, the **S4+**, which stands for **smart specialisation strategies for sustainable and inclusive growth**, as initially proposed in the report by McCann and Soete (2020). Nevertheless, the S4+ is only an academic discussion for now, not a political one yet since it's not part of the current EU legislative framework. Nonetheless, some regions are using the term S4 in their regional strategies as a branding exercise to emphasise that they're taking up the sustainability dimension. Lastly, there were the opinions of **disjuncture between these two strategies**, explained by two main reasons - due to the ambiguity in the S3 policy scope and due to the differences in the optimal implementation level; the S3 is designed at regional level since its dealing with regional strengths, while CE policies are designed at more strategic geographical level.

In terms of the **nature of influence between the S3 and CE**, the interview results **unveiled a less deterministic relationship** (**section 5.3.6**) compared to the survey results (**section 5.2.2**),

where all participants uniformly answered that the relationship between S3 and CE is positive in nature. Certainly, the **possibility of having a positive path dependency situation** in a region where both strategies are complementing and leveraging on each other was recognised as a positive scenario. However, the **risks of adverse influence, including risks of regional lock-ins in linear supply chains, problematic regional trajectories and potential negative path-dependency situation** were also underlined.

One of the biggest identified **risks of regional lock-in was emerging from the unfit heuristic of S3 in prioritising areas of regional strength**, which are in economic activities that are often unsustainable in some fundamental dimension, therefore, not fit for the purpose of a broader sustainability transition. **Potential production cycle lock-ins due to geographical and geopolitical factors** were introduced, as well as analogous risks, related to the **regional supply chains limitations**. Specifically, the **economic and environmental inefficiency determinants** which sometimes can be against for developing regional supply chains were noted along with the inter-regional dependency for some value chains and the **complex interplay required beyond regional level**. Additional risk arising from overlooking transition and cross-sectoriality in the current S3 thematic platform was acknowledged.

The possibility of S3 and CE having **both positive and negative influence** was presented through the prism of **trade-offs and complementarities**, where the success parameter is whether CE activities can be applied at scale, over long-term commitments in lagging behind regions, and not just in economically advanced territories (elaborated in **section 5.3.7** and **section 5.5.3**). Another determinant is based on **how regions interpreted S3**, which in turn influenced how efficient (or inefficient) links were established between S3 and CE afterwards. Namely, the distinction was made between **regions that have been interpreting S3 narrowly**, perceiving it as a regulatory obligation and administrative procedure to obtain EU funds, and **regions that have captured S3 as transformative strategy** incorporating innovative approaches, therefore comprehending the strategic aspect behind the strategy. The **constellation of stakeholders also proved as vital** in determining the nature of the relationship between the two policies. Ultimately, the **monopolistic situation where key industrial players are dominating the transition needs to be avoided, and inclination towards a more ecosystem configuration needs to be ensured**.

Some of the main reasons for regional lock-in encompass the **tensions due to the incumbent structures and networks confrontation** and the **risk of key industrial players in unsustainable core industries lobbying and monopolising the CE agenda**. Moreover, the ambiguity of the CE and S3 concepts which is resulting in **vagueness in the related strategies and undefined boundaries**, combined with the **inability to ensure perpetuity between the political cycles** and continuity of the work of the regional authorities is another interlinked reason. This is because the discussion has expanded from being mostly environment and waste oriented, to a more overarching discussion involving many ministries, departments, and competencies; however, in order to have a more unified direction of activities, functional governance structures and effective institutional environment are essential (as elaborated in **section 5.5.1**). Nevertheless, the most important one was inherited in the **S3 heuristic, where prioritisation in areas of strengths is often defined in unsustainable activities**. A most prominent example are the regions with **Natural Resource-Based Industries (NRBIs)**, like coal regions, which in their S3 identified priority areas very close to unsustainable activities, now due to be phased out by 2030 because of EU legal commitments.

Ideally, certain **risk mitigation mechanisms** need to be considered in order to alleviate the risks which were listed above. This involves **including CE elements in existing unsustainable industry** as the starting point or preferably **repurposing the existing industry utterly towards CE**. **Supporting the interested SMEs willing to transition towards CE** in order to avoid key industrial players dominating the CE agenda, as well as addressing the need to develop inter-regional supply chains were other suggested courses of action. Regarding the risk of problematic trajectories emerging from the unfit heuristic of the current S3 for broader sustainability transition, the **PRI instrument** (elaborated in **section 5.3.7** and **5.5.5**) was introduced as potential risk mitigator. The PRI instrument is holding the premise of a new heuristic emphasising sustainable development *“that draws not just on strengths, but also on the challenges that the region faces and opportunities that could be grasped through innovation”*. Two studies reflecting on how S3 needs to adapt to become suitable for more transformative innovation with EU sustainability were identified, the first one by Pontikakis et al. (2020) in the context of industrial transition and the second one by Miedzinski et al. (2021) in the context of the SGDs.

Lastly, several general conclusions emerged regarding the S3. A vital **distinction was made between EU regions regarding the varying importance S3 has, which depends on the importance of EU funds for the region.** In wealthier regions S3 is only one of the many strategies available to promote transition, but economically weaker regions depend fully on structural funds. Therefore, it is crucial to see these institutional differences in the bigger picture, in order to avoid having inaccurate and generic conclusions. Additional analysis needs to be made to identify potential patterns, and uncover these differences tied to the division of power of the specific MS and the role and importance of the structural funds within the MS (issues mentioned in **sections 5.3.1 and 5.3.2**). The study of Hegyi et al., (2021) provided similar conclusions, where less developed regions exhibited poorer implementation performance of S3. Additionally, the lack of capacity and weak inter-government coordination mechanisms within the public administration in implementing specific measures was identified as the key reason for slower strategy implementation.

As for the links between S3 and CE in decentralised MS, a remark was made that this is relying heavily on the **regional leadership**, and whether S3 is used for systemic change and finding directionality for the whole region or is just a process for receiving structural fund. Similarly, the findings of the above-mentioned study investigating how S3 were governed, revealed overwhelmingly a silo approach, particularly in some MS S3 was not recognised as opportunity that it is for more holistic planning, but it became yet another way of managing one of the priorities of ERDF, priority one for support to innovation (Hegyi et al., 2021).

5.5.5 Partnerships for Regional Innovation (PRI) initiative

The **Partnerships for Regional Innovation (PRI) initiative** is another determinant which has the potential to positively influence the development and implementation of the CE policies within EU regions. Despite being still in a piloting phase not currently supported by any legislative framework, it appears to be one of the most promising instruments, as put forward both by EU policy experts working closely on this pilot, but also by regional policy experts working in regional authorities of regions which are partaking in this initiative. As highlighted in **section 5.3.7** the main reason why the JRC is investing in this instrument is due to its **potential to establish a framework more receptive to transformation, especially in**

lagging behind territories, which is elaborated in the recent report by Pontikakis et al. (2022). Furthermore, the narrative of the PRI approach is going way beyond of being a mere implementation tool for the Cohesion policy, but rather a **way to bridge out of the ‘Cohesion ghetto’ and go towards the transition world with development of regional transitional strategies which engages a diverse set of policies**. Although the participation in the PRI pilot is on a voluntarily basis, an increased interest of regions is being noted, because they **perceive it as an accelerator for tackling many interrelated problems**, which can have **potential mimetic stimuli** for future engagement.

As illustrated in **Figure 57**, PRI is also influencing the S3, particularly the risk of problematic trajectories emerging from the unfit heuristic of the current S3 for broader sustainability transition, hence, **acting as potential risk mitigation mechanism**. The PRI instrument as introduced in **section 5.3.6** is holding the premise of a **new heuristic emphasising sustainable development that draws not just on strengths, but also on the challenges that the region faces and opportunities that could be grasped through innovation**. Therefore, the flaw of S3 emerging from the sole focus on regional competitive advantages is being addressed via the PRI by taking into account the regional opportunities and challenges, an important determinant mentioned also in **section 5.5.1**. Nevertheless, in order to materialise all prospective benefits of this instrument many challenges need to be addressed, as well as political capital and capacities needs to be invested.

5.5.6 Tracking the regional performance

All previously described building blocks of the conceptual framework are resulting in some type of impact for the regions, which certainly needs to be monitored. **Tracking the regional performance** of circular transition was perceived as **prerequisite for informed decision making, ensuring the direction and speed of policy implementation for target attainment**, as elaborated in the dedicated **section 5.3.10**. Moreover, **transparency should be safeguarded**, and **periodic adjustments and revision mechanisms** should be foreseen in order to account for the latest developments and adjust policies and instruments.

The **vagueness of frontiers between measuring the progress of CE and monitoring the undertaken activities** became evident during the interviewing process. **Monitoring the**

invested activities, initiatives, and financial resources, representing the input side, while **measuring the % of circularity of the region is representing the output side**. The majority of the existing recorded efforts are on the input side, where regional administrations are keeping some sort of internal project-based monitoring. However, both monitoring and measuring of the input and output sides are equally important, and they should be in constant interaction. An overall regional monitoring framework should exist for this purpose, which should be **ecologically sensitive, suitable for driving a socio-ecological transition**, therefore monitoring activities and results related **to economic, social, and environmental aspects**.

A **wide range of difficulties related to the measurement and monitoring of the CE transition** have been reported, starting from more theoretical and conceptual ones to more technical and practical ones. The difficulties related to the CE measurement appear to be **inherited by the ambiguity of the CE scope overall**. CE is an evolving concept which cannot be defined by a few indicators, and the existing traditional indicators are **unable to capture the real impact of the CE**, which is implying a transformative change. Additional issue which is hindering the measurement process has to do with the **standardisation challenges** along with the **underrepresentation of measurements related to the social dimension**. The overall data framework indispensable to measure the CE transition appears to be absent, as well as current **lack of an integrated measurement framework** at the regional level has been observed. Hence, there is a **general need for new metrics to evaluate transformative processes**, like the transition towards CE model and this is a challenge not only for the regions, but a global challenge. This is in line with some of the findings from several studies, also identifying lack or regional measurement and monitoring framework (Avdiushchenko and Zajač, 2019; Scarpellini et al., 2019; Avdiushchenko, 2018). **Fragmented and uncoordinated efforts** were another big obstacle which was reported on several occasions, for data collection but also for data processing. Last but not least, the ability and capacity of regional authorities to develop policy intelligence for developing indicators, making an informed use of the developed indicators and evidence-based policymaking, is generally lower compared to the capacity of the national authorities.

The **regional data availability issue** was one of the main obstacles which was underlined in many of the discussions faced by several regions. The available data at the regional level is **mostly focusing on waste** and related areas, because **waste is a regional competence in a lot**

of MS. The **lack of data on the specific regional scale** was another barrier which was encountered in two distinct scenarios. Namely, the existence of national data that needs to be disaggregated at the regional level and the municipal data which needs to be aggregated at the regional level. Other related barriers included the **broader capacities and resources issue emerging from the centralised statistical systems, data reliability and data quality concerns, lack of innovative approaches** being adopted and the **laggard feature of statistics overall**. Moreover, the **lack of detailed data** and the difficulties to develop and sustain input for very detailed metrics was mentioned, along with the **reluctance of companies to supply financial data** to the statistical offices. Both the regional data availability issue and the abovementioned difficulties in the measurement and monitoring activities are in line with the findings from the survey (**section 5.2.3**), providing explanations for the survey results. The majority of the regions in the survey were still in the process of planning and developing specific regional CE indicators (22 experts representing 19 regions), while 9 experts stated they are not measuring the progress towards the CE in their respective region. The lack of regional data issue and challenges in terms of regional data availability were encountered in many studies, already stated in **chapter 2**. (Tazi et al., 2021; Towa et al., 2021; Towa et al., 2021a; Towa et al., 2021b; Arbolino et al., 2020; Baniyas et al., 2020; Bianchi et al., 2020; D'Adamo et al., 2020; Gardiner and Hajek, 2020; Mihai and Grozavu, 2019; Patricio et al., 2020; Silvestri et al., 2020; Agovino et al., 2019; Christis et al., 2019; Virtanen et al., 2019; Volk et al., 2019; Arbolino et al., 2018; Avdiushchenko, 2018; Sastre et al., 2018).

Finally, some courses of actions and potential initiatives were proposed in order to address the issue of regional data availability, measurement and monitoring of the regional progress towards CE. The **involvement of academic actors and research institutes** in both data collection and developing measurement frameworks was suggested. Another recommendation was to **leverage on regulatory compliance**, national or regional laws, to induce data collection from industry, and the corporate sustainability reports were mentioned as a new dataset that might be of use. The idea of the **EU to provide some sort of general guidance**, a non-binding document, on how to develop a regional data framework or apply the existing EU CE monitoring framework on the regional level was considered as useful, and the role of the CCRI in this was underlined. The harmonised framework will enable comparison between regions, but it can also be perceived by regions as an **extra layer of**

boreoarctic obligation which can have an adverse impact. Moreover, the **development of certain frameworks and indicators within interregional EU projects** was noted as beneficial in some cases. The potential **role of circular hubs** as public-private network for data collection was underlined as well as the **need to utilise innovative approaches and available advanced technologies** for data collection and generation. Namely, to **leverage on the twin transition** particularly was emphasised - *“digitalisation and CE we always say they should go hand by hand, this is one dimension where they’re not going hand by hand yet”*.

Chapter six: Conclusion

6.1 Thesis summary and key emerging findings

A summary of the thesis is provided in this concluding chapter with brief outline of the process followed since the beginning of the research, structured in the different chapters comprising this PhD work. Additionally, an overview of the key emerging findings from this research and how they contributed towards meeting the research aim and addressing the research questions is provided.

- ⇒ In **chapter 1** a brief introduction was provided, setting up the research context and the outline of the thesis.
- ⇒ In **chapter 2** a literature review was conducted to explore the existing academic knowledge base regarding the implementation of CE policies at the European regional level. In order to circumvent the limitations and inherited biases of the traditional narrative literature review, a systematic literature review method was selected, entailing a rigorous, replicable, and transparent six-step process. The review was conducted using Scopus and WoS databases and overall, 82 relevant papers were identified through the review, which proceeded to descriptive, bibliometric, and content analysis. This study found that generally, the importance of regions as an implementation level for adopting CE has been acknowledged. Nevertheless, the related research is still in an infancy stage, despite the increased interest of scholars in the recent period. Seven groups of findings were identified which emerged from the literature review, including 1) general findings related to the field of regional CE, 2) findings related to the implementation level, 3) policy-related findings, 4) findings related to the approach of implementation, 5) findings related to drivers and barriers for implementation, 6) findings related to mechanism/instruments for implementation and 7) findings related to monitoring and measurement systems.
- ⇒ The emerging findings from the literature review were validated and further enriched with the findings from the grey literature performed in **chapter 3**. Namely, the recent developments in the EU policy fora were initially analysed to set the ground for more local policy efforts presented afterwards. The practical insights regarding the measurement systems were briefly denoted, along with the drivers and barriers encountered at the

regional level for adopting CE policies. The grey literature analysed for this purpose included policies, strategies, action plans, regulations, directives, and public reports prepared by either public institutions or Think Thanks. Finally, a secondary data analysis was conducted for eight EU regions, exploring their CE-related strategies and existing S3. The selection strategy including the selection criteria and process followed was explained initially, and the results per region were presented afterwards in so-called Regional Blueprints.

- ⇒ In **chapter 4** the main research aim and research questions of the empirical study were formulated (see **Table 42**). Afterwards, institutional theory as the selected theoretical framework of the research was presented, along with the carefully designed research methodology in order to address the main research aim and research questions. Namely, a four-stage policy Delphi study was designed, where phase one included nomination and selection of policy experts. In the second phase a brief online survey was delivered to policy experts in regional administrations mostly. In the third phase online individual interviews with regional policy experts were conducted in order to explore deeper the initial results from the survey. The results from both phases were then summarised in a form of Policy Brief and distributed online to the participants from the previous phases, in order to corroborate them. The data analysis procedures, along with ethical considerations and main limitations of the selected research methods were stated as well.
- ⇒ **Chapter 5** had twofold goals, first to present the results from the policy Delphi study, and second to present the conceptual framework emerging from the empirical research overall. Hence, the survey results from 42 policy experts were analysed initially, followed by a detailed and very structured template analysis of the interview transcripts from the 19 online conducted interviews. In total 10 main themes emerged from the template analysis, including 1) the regional narrative in the CE transition, 2) division of power as common denominator for EU regions, 3) multi-level governance mechanisms, 4) formulation & implementation of developmental strategies, 5) architecture of regional CE policies, 6) S3 & CE nexus: influences, risks & mitigation mechanisms, 7) EU Green Deal & CE policies: formulation, implementation & main challenges, 8) institutional pressures driving the adoption of regional CE policies, 9) the vital role of CE hubs (networks) in the transition and 10) regional frameworks for measuring and monitoring CE progress. The main policy

implications from both phases were presented in a very cohesive manner in a Policy Brief format, distributed for validation to the participants in the previous stages of the study. The feedback received was incorporated and the conceptual framework resulting from the whole empirical study was graphically illustrated and discussed in detail. The main research aim and research questions were addressed with the findings from the empirical study, and the related synthetic description was presented in **Table 42**. Additionally, the links between the empirical findings from the proposed conceptual framework and the initially stated RQs were visually represented in **Figure 58**. Lastly, in **Figure 59** the all-encompassing relations were presented between the initial RQs, the findings from the academic and grey literature and how ultimately they were associated with the empirical findings from the conceptual framework.

⇒ And as already stated in the beginning of this section, **chapter 6** provided the concluding remarks, the main policy implications from the thesis and some futures lines of inquiries.

Research Aim and RQs	Related findings
Research aim: To investigate whether Smart Specialisation Strategies (S3) influence the adoption of circular economy policies at the regional level.	A mutual interaction has been uncovered to exist between S3 and CE policies at the regional level. However, an important distinction was made concerning the indispensability between the two policies. Namely, the CE approach doesn't necessary imply a S3, while the priority of the S3 should be to embody the CE as way of thinking, building up a strategy based on green, inclusive, and smart complementarities. (Related sections: 5.2.2, 5.2.5, 5.3.6, 5.3.7, 5.4, 5.5, 5.5.4, 5.5.5)
RQ1: How does Smart Specialisation Strategies (S3), as (normative) institutional pressures, influence the adoption of circular economy policies at the regional level? In that context, does S3 impel the adoption of circular economy policies at the regional level, or in contrary it constitutes a form of lock-in which could even impede a region to adopt circular economy policies?	A less deterministic relationship appeared to exist with several risks of adverse influence, including risks of regional lock-ins in linear supply chains and potential negative path-dependency situation were underlined. The possibility of S3 and CE having both positive and negative influence was presented through the prism of trade-offs and complementarities, how regions interpreted S3 which influenced how efficient (or inefficient) links were established between S3 and CE afterwards and the constellation of stakeholders. Some of the main reasons for regional lock-ins were identified and pertinent risk mitigation mechanisms were proposed. (Related sections: 5.2.2, 5.2.5, 5.3.6, 5.3.7, 5.4, 5.5, 5.5.4, 5.5.5)
RQ2: What is the corresponding impact on regional performance across a number of economic, social, and environmental metrics, of selected EU regions?	An overall lack of monitoring and measuring framework for tracking the regional CE transition was acknowledged. A distinction should be made between measuring the invested activities, initiatives and financial resources on the input side,

	and the % of circularity of the region presented on the output side. However, wide range of difficulties have been reported in the surveyed regions, along with major regional data availability issues, which was one of the main obstacles underlined throughout the study. (Related sections: 5.2.4, 5.2.5, 5.3.10, 5.4, 5.5, 5.5.6)
RQ3: What other institutional pressures, normative, coercive, and mimetic, are influencing the adoption of circular economy policies at the regional level?	The findings revealed an existing two-way mechanism influencing the CE policy within the EU regions. Namely, the predominance of international and EU legislation (legislative pressure), representing a top-down approach and the regional stakeholders representing the regional eco-system (normative pressure), indicating a bottom-up approach. The vital role of the regional CE hubs (networks) was also highlighted, as another normative pressure which can certainly boost the CE transition. Nevertheless, the need to shift the relative importance of normative and mimetic pressures in the future, as well as increase the influence of national and regional legislation was highlighted. (Related sections: 5.2.4, 5.2.5, 5.3.8, 5.3.9, 5.4, 5.5, 5.5.2, 5.5.2.1)

Table 42: Research findings addressing the RQs

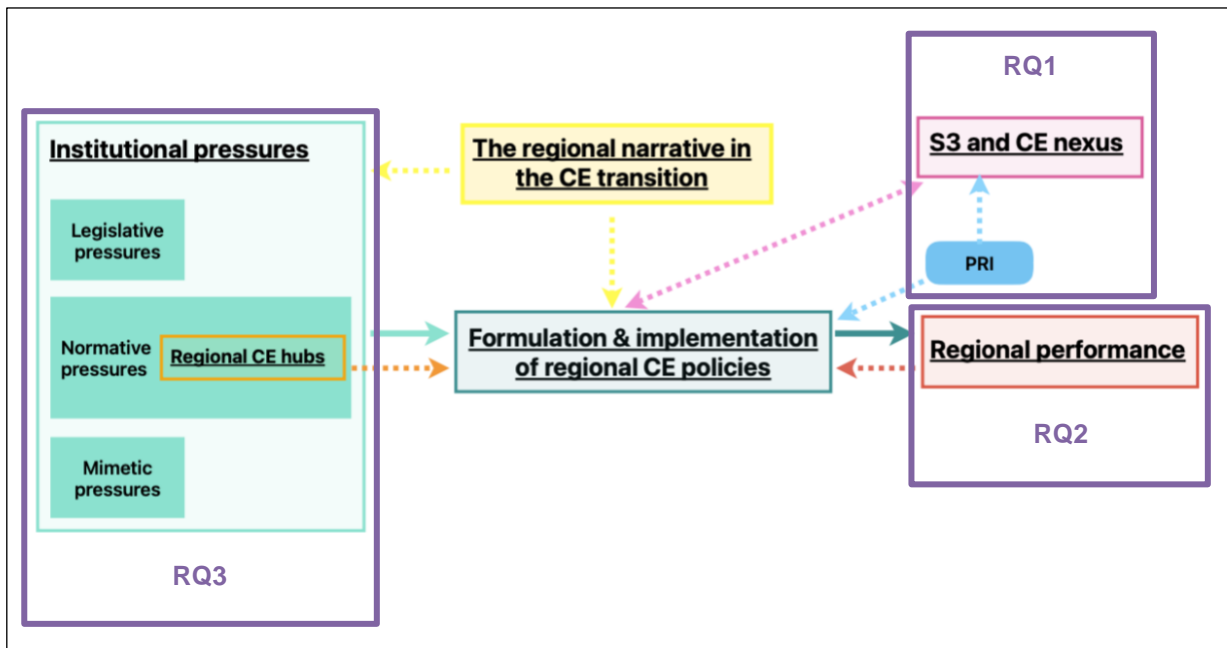


Figure 58: Visual representation of the relation between RQs and empirical findings from conceptual framework (section 5.5)

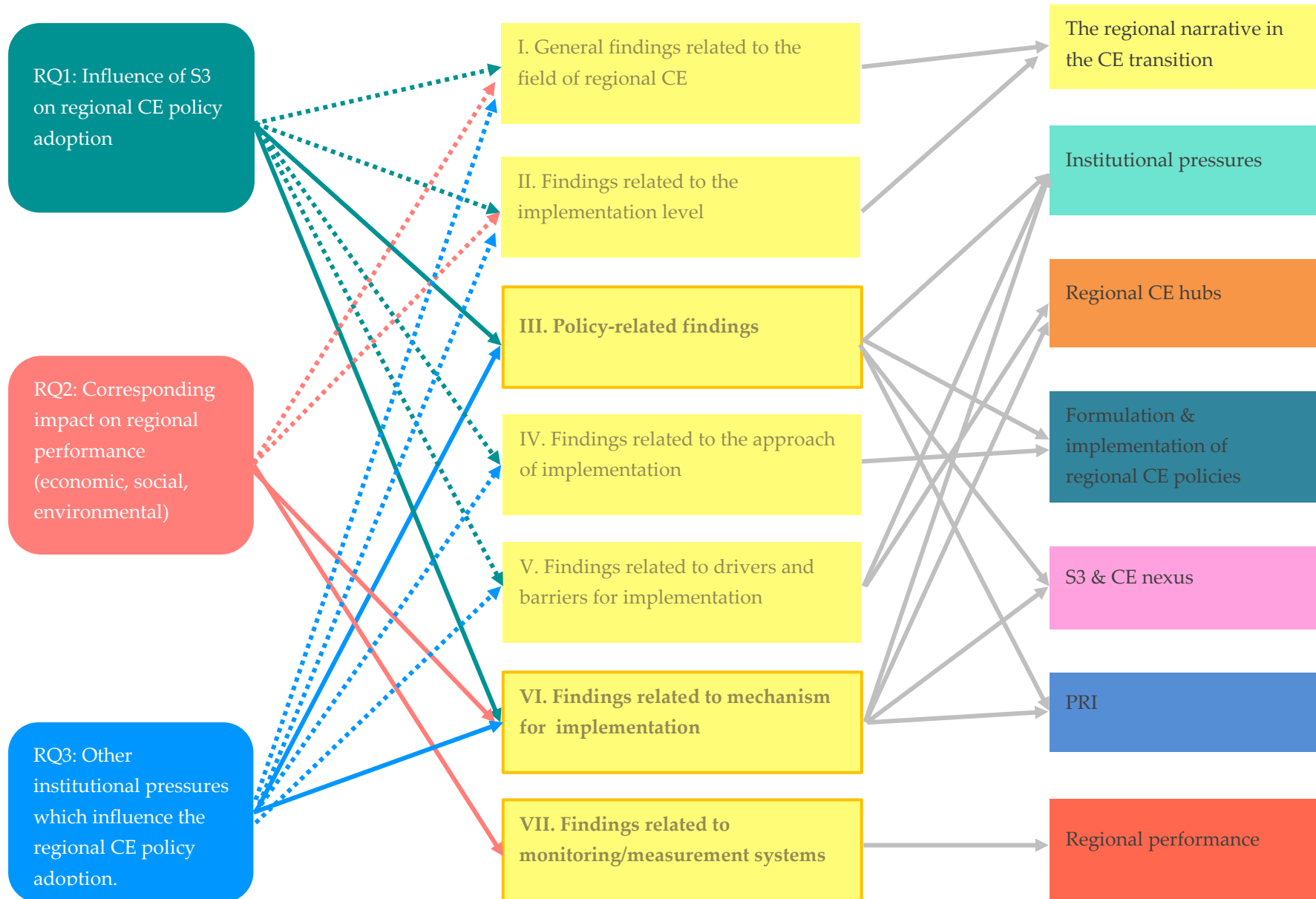


Figure 59: Visual representation of the relations between the RQs, the findings from the academic and grey literature (section 2.6 and 3.6) and the empirical findings from the conceptual framework (section 5.5)

6.2 Original contribution and policy implications

This research offers important contributions to both theory and practice. **Chapter 2** was the first attempt to provide a holistic systematic literature review in the regional CE domain, presenting an important initial contribution in the direction of establishing robust conceptual frameworks which involve the constructs of regional CE and laying the groundwork for future studies in this field. More importantly, it contributes to theoretical advancement, because is the first study proposing and adopting the institutional theory lens to study the implementation of CE policies within a wider EU regional context, providing a new field where this theory is applied. Additionally, to the best of the researchers' knowledge, this is the first study which applies the rigorous policy Delphi method devised for the purpose of addressing the formulation and implementation of CE policies, enlarging the application fields of this particular instrument for policy development. The emerging findings presented in the conceptual framework with the related constructs can be of interests for partitioners, offering practical contribution and original knowledge for encouraging bottom-up CE initiatives in their territory of operation. Last but not least, this empirical study has provided unique insights into the understanding of the regional policy development and policy implications of the CE paradigm which can be used to establish new policy initiatives or adjust already existing policies, with the ultimate goal to unlock the full potential of the EU regions for the CE journey.

6.3 Future lines of research

To the best of the researcher's knowledge, this is the first policy Delphi study attempting to provide a holistic analysis of the CE policy implementation within the EU regional context. Hence, the findings from the empirical study along with the preliminary conceptual framework devised is considered as a crucial initial contribution in the direction of establishing a more robust conceptual frameworks which involve the constructs of regional circular economy and laying the groundwork for future studies in this field. The limitations related to the systematic literature review and the selected research methods have been presented in **section 2.7** and **section 4.9** respectively, and they can serve as a baseline for

refining and encouraging future research on the topic. Namely, the overall participation in the empirical study can be enriched, since in total in all stages of the policy Delphi study there were 51 participants, representing 32 different NUTS 2 regions (out of 242 NUTS 2 regions) and 20 EU countries. Therefore, a larger sample of participants, representing a larger number of EU regions will be beneficial, in order to increase the reliability of generalising the results. Additionally, enrichment of the database of surveyed regions can be done and cross-checked with some of the studies done by JRC and OECD, regarding the EU divide and green readiness of EU regions. Considering the importance of the regional narrative and diverse set of institutional pressures in each region, a typology of regions needs to be developed with regional archetypes, which will result in more tailored and case-specific policy recommendations which can be provided. Finally, the preliminary conceptual framework with the proposed constructs devised in **section 5.5** can be tested and enriched in future empirical studies.

Appendix A: Reviewed Articles

Title	Author	Year of publication	Methodology	Country	Geographic territory	NUTS Relation
Circular economy scenario modelling using a multiregional hybrid input-output model: The case of Belgium and its regions	Towa E., Zeller V., Achten W.M.J.	2021	Quantitative	Belgium	Belgium, Brussels, Flanders, and Wallonia	National, NUTS 1
Towards Circular Economy through Industrial Symbiosis in the Dutch construction industry: A case of recycled concrete aggregates	Yu Y., Yazan D.M., Bhochhibhoya S., Volker L.	2021	Quantitative	The Netherlands	Twente	NUTS 3
Smart specialisation strategies for elevating integration of cultural heritage into circular economy	Stanojev J., Gustafsson C.	2021	Mixed	EU wide	243 EU NUTS regions	Probably NUTS 2 (not specified)
Emerging circular economies: Discourse coalitions in a Norwegian case	Ortega Alvarado I.A., Sutcliffe T.E., Berker T., Pettersen I.N.	2021	Qualitative	Norway	Trøndelag	NUTS 2
An empirical analysis of driving factors and policy enablers of heritage adaptive reuse within the circular economy framework	Kaya D.I., Pintossi N., Dane G.	2021	Mixed	The Netherlands, Italy, Croatia, Sweden	Cities of Amsterdam, Salerno, Rijeka, Västra Götaland	NUTS 3, NUTS 3, lower than NUTS 3 based on population, NUTS 3
Adapting a circular economy in regional strategies of the European Union	Vanhamäki S., Rinkinen S., Manskinen K.	2021	Qualitative	Belgium, Denmark, Finland, Germany, Luxembourg, Romania, Slovenia, Spain	Brussels Capital Region (BCR), Central Denmark, Southwest Finland, Häme, Pajala Häme, Satakunta, Berlin,	NUTS 2, NUTS 2, NUTS 3, NUTS 3, NUTS 3, NUTS 2, NUTS 2, NUTS 1, NUTS 2, NUTS 1, NUTS 2

					Brandenburg, Luxembourg, Sud- Muntenia, Slovenia, Basque country	
An overview of the transition to a circular economy in Emilia-Romagna region, Italy considering technological, legal-regulatory and financial points of view: A case study	Sani D., Picone S., Bianchini A., Fava F., Guarnieri P., Rossi J.	2021	Qualitative	Italy	Emilia Romagna	NUTS 2
The Role of Institutions in Creating Circular Economy Pathways for Regional Development	Henrysson M., Nuur C.	2021	Conceptual paper	Finland, Belgium, Poland, Spain	Pajat Hame, Brussels Capital Region, Malopolska, Extremadura	NUTS 3, NUTS 2, NUTS 2, NUTS 2
Assessing the circularity of regions: Stakes of trade of waste for treatment	Towa E., Zeller V., Achten W.M.J.	2021	Quantitative	Belgium	Brussels, Flanders, and Wallonia	NUTS 1
Domesticating circular economy? An enquiry into Norwegian subnational authorities' process of implementing circularity	Sutcliffe T.E., Ortega Alvarado I.A.	2021	Qualitative	Norway	Trøndelag county and municipality of Trondheim	NUTS 2 and based on population the municipality could be considered as NUTS 3
Eco-innovations towards circular economy: evidence from cases studies of collective methanisation in France	Gonçalves A., Galliano D., Triboulet P.	2021	Mixed	France	South-West France	Based on population could be considered as larger than NUTS 1
Regional waste footprint and waste treatments analysis	Towa E., Zeller V., Merciai S., Achten W.M.J.	2021	Quantitative	Belgium	Brussels, Flanders, and Wallonia	NUTS 1
Exploring a regional repair network with a public funding scheme for	Lechner G., Wagner M.J., Diaz Tena A., Fleck C., Reimann M.	2021	Mixed	Austria	Graz	NUTS 3

customer repairs: The 'GRAZ repariert'-case						
Best-compromise solutions for waste management: Decision support system for policymaking	Boffardi R., De Simone L., De Pascale A., Ioppolo G., Arbolino R.	2021	Quantitative	Italy	Campania	NUTS 2
Towards achieving circularity in residential building materials: Potential stock, locks, and opportunities	Tazi N., Idir R., Ben Fraj A.	2021	Quantitative	France	Grand-Est, Occitanie, Nouvelle-Aquitaine, Auvergne-Rhone-Alpes, Bourgogne-Franche-Comte, Bretagne, Center-Val de Loire, Ile-de-France, Hauts-de-France, Normandie, Pays de la Loire, Provence-Alpes-cote d'Azur, Corse	NUTS 1, NUTS 1, NUTS 1, NUTS 1, NUTS 1/2, NUTS 1/2, NUTS 1/2, NUTS 1, NUTS 1/2, NUTS 1/2, NUTS 1/2
When institutional logics meet: Alignment and misalignment in collaboration between academia and practitioners	Ingstrup M.B., Aarikka-Stenroos L., Adlin N.	2021	Qualitative	Finland	CE cluster from the Tampere Region	The region is NUTS 3, but the authors are focused on the cluster
Entrepreneurial Drivers for the Development of the Circular Business Model: The Role of Academic Spin-Off	Poponi S., Arcese G., Mosconi E. M., di Trifiletti M. A.	2020	Qualitative	Italy	Lazio	NUTS 2
Exploring regional transitions to the bioeconomy using a socio-economic indicator: the case of Italy	D'Adamo I., Falcone P. M., Imbert E., Morone P.	2020	Quantitative	Italy	20 NUTS 2 Italian regions	NUTS 2

The separate collection of recyclable waste materials as a flywheel for the circular economy: the role of institutional quality and socio-economic factors	Agovino M., Ferrara M., Marchesano K., Garofalo A.	2020	Quantitative	Italy	103 Italian provinces NUTS 3	NUTS 3
Regional policies for circular economy in Italy and an empirical analysis of pay-as-you-throw tax effects in Emilia-Romagna	Compagnoni M.	2020	Mixed	Italy	Emilia Romagna	NUTS 2
Circular economy good practices supporting waste prevention: The case of Emilia-Romagna Region	Cappellaro F., Fantin V., Barberio G., Cutaia L.	2020	Qualitative	Italy	Emilia Romagna	NUTS 2
An insight into the Italian chemical sector: How to make it green and efficient	Arbolino R., Boffardi R., Ioppolo G.	2020	Quantitative	Italy	20 NUTS 2 Italian regions	NUTS 2
Responsibility as a field: The circular economy of water, waste, and energy	Savini F., Giezen M.	2020	Qualitative	The Netherlands	City region of Amsterdam	NUTS 3
The function of transition brokers in the regional governance of implementing circular economy - A comparative case study of six dutch regions	Cramer J.M.	2020	Qualitative	The Netherlands	Province of Utrecht, Provinces Gelderland and Overijssel, Nijmegen Area, Friesland, Mid Brabant, Amsterdam Metropolitan Area	NUTS 2/3, NUTS 2, NUTS 2, NUTS 3, NUTS 2, NUTS 3, can be considered NUTS 2 based on population
Systemic design for policymaking: Towards the next circular regions	Nohra C.G., Pereno A., Barbero S.	2020	Qualitative	Italy, Spain, France, Romania, Slovenia	Piedmont, Basque Country, Nouvelle Aquitaine, Northeast Romania, and Slovenia	NUTS 2, NUTS 2, NUTS 1, NUTS 2, NUTS 1
Regional development of Circular Economy in the European Union: A multidimensional analysis	Silvestri F., Spigarelli F., Tassinari M.	2020	Quantitative	EU wide	169 EU NUTS 2 regions	NUTS 2

Transition towards a circular economy at a regional level: A case study on closing biological loops	Vanhamäki S., Virtanen M., Luste S., Manskinen K.	2020	Qualitative	Finland	Päijät-Häme	NUTS 3
The role of institutional engagement at the macro level in pushing the circular economy in Spain and its regions	Alonso-Almeida M.M., Rodríguez-Antón J.M.	2020	Mixed	Spain	Andalusía, Aragon, Asturias, Cantabria, Castilla La Mancha, Castilla-Leon, Catalonia, Ceuta, Community of Madrid, Valencian Community, Extremadura, Galicia, Balearic Islands, Canary Islands, Community of La Rioja, Melilla, Foral Community of Navarre, Basque Country, Muccia	NUTS 2, NUTS 2, NUTS 2/3, NUTS 2/3, NUTS 2, NUTS 2, NUTS 2/3, NUTS 1, NUTS 2, NUTS 2, NUTS 2, NUTS 2, NUTS 2/3, NUTS 2, NUTS 2, NUTS 2/3
Methodological framework for the implementation of circular economy in urban systems	Sánchez Levoso A., Gasol C.M., Martínez-Blanco J., Durany X.G., Lehmann M., Gaya R.F.	2020	Qualitative	The Netherlands, United Kingdom, Spain, France	Amsterdam, Glasgow, Bilbao and Bizcaia, London, Paris, Rotterdam, Mataro, other area in Catalonia	NUTS 3, NUTS 3, NUTS 3, NUTS 3 (probably the city of London), NUTS 3, based on population lower than NUTS 3, lower than NUTS 3, lower than NUTS 3
The progressive adoption of a circular economy by businesses for cleaner production: An approach from a regional study in Spain	Aranda-Usón A., Portillo-Tarragona P., Scarpellini S., Llena-Macarulla F.	2020	Qualitative	Spain	Aragon	NUTS 2
Assessing the sustainability of urban eco-systems through Emergy-based circular economy indicators	Santagata R., Zucaro A., Viglia S., Ripa M., Tian X., Ulgiati S.	2020	Quantitative	Italy	Municipality of Naples	Could be considered as lower than NUTS 3 based on population

Exploring Local Business Model Development for Regional Circular Textile Transition in France	Real M., Lizarralde I., Tyl B.	2020	Qualitative	France	Nouvelle Aquitaine	NUTS 1
System solutions for the circular economy on the regional level: The case of Green Lungs of Poland	Drejerska N., Vrontis D., Siachou E., Golebiewski J.	2020	Qualitative	Poland	Podlasie	NUTS 2
Monitoring domestic material consumption at lower territorial levels: A novel data downscaling method	Bianchi M., Tapia C., del Valle I.	2020	Quantitative	EU wide	280 EU NUTS 2	NUTS 2
A life cycle analysis approach for the evaluation of municipal solid waste management practices: The case study of the region of Central Macedonia, Greece	Banias G., Batsioulas M., Achillas C., Patsios S.I., Kontogiannopoulos K.N., Bochtis D., Moussiopoulos N.	2020	Quantitative	Greece	Central Macedonia	NUTS 2
Municipal waste generation, R&D intensity, and economic growth nexus – A case of EU regions	Gardiner R., Hajek P.	2020	Quantitative	EU wide	284 EU NUTS 2 regions	NUTS 2
Circular bioeconomy via energy transition supported by Fuzzy Cognitive Map modelling towards sustainable low-carbon environment	Kokkinos K., Karayannis V., Moustakas K.	2020	Mixed	Greece	Thessaly	NUTS 2
Experimenting with circularity when designing contemporary regions: Adaptation strategies for more resilient and regenerative metropolitan	Amenta L., Qu L.	2020	Qualitative	The Netherlands, Italy	Metropolitan Areas of Amsterdam and Naples	Can be considered as NUTS 2 and NUTS 1 regions respectively based on population

areas of Amsterdam and Naples developed in university studio settings						
A method and databases for estimating detailed industrial waste generation at different scales – With application to biogas industry development	Patricio J., Kalmykova Y., Rosado L.	2020	Quantitative	Sweden	Västra Götaland	NUTS 3
Plastic waste management: a comprehensive analysis of the current status to set up an after-use plastic strategy in Emilia-Romagna Region (Italy)	Foschi E., D'Addato F., Bonoli A.	2020	Mixed	Italy	Emilia Romagna	NUTS 2
First worldwide regulation on sustainable landfilling: Guidelines of the Lombardy region (Italy)	Cossu R., Sciunnach D., Cappa S., Gallina G., Grossule V., Raga R.	2020	Qualitative	Italy	Lombardy region	NUTS 2
Definition and measurement of the circular economy's regional impact	Scarpellini S., Portillo-Tarragona P., Aranda-Uson A., Llana-Macarulla F.	2019	Qualitative	Spain	Aragon	NUTS 2
Resources, Collaborators, and Neighbours: The Three-Pronged Challenge in the Implementation of Bioeconomy Regions	Bezama A., Ingrao C., O'Keeffe S., Thraen D.	2019	Qualitative	EU wide	This paper refers to EU regions, but doesn't point a specific region	N/A
The good and the bad: Identifying homogeneous groups of municipalities in terms of separate waste collection determinants in Italy	Agovino M., Cerciello M., Musella G.	2019	Quantitative	Italy	Around 8000 Italian Municipalities	Based on population smaller than NUTS 3

Barriers and challenges to plastics valorisation in the context of a circular economy: Case studies from Italy	Paletta A., Leal Filho W., Balogun A.-L., Foschi E., Bonoli A.	2019	Mixed	Italy	Emilia Romagna	NUTS 2
The economy that runs on waste: accumulation in the circular city	Savini F.	2019	Conceptual paper	The Netherlands	Amsterdam city-region	Greater Amsterdam (or Groot-Amsterdam) is NUTS 3. The author talks about Amsterdam city-region; hence a conclusion is made that he refers to the NUTS 3 and not the municipality of Amsterdam
Regional material flow tools to promote circular economy	Virtanen M., Manskinen K., Uusitalo V., Syväne J., Cura K.	2019	Qualitative	Finland	Päijät-Häme	NUTS 3
Towards a more direct policy feedback in circular economy monitoring via a societal needs perspective	Alaerts L., Van Acker K., Rousseau S., De Jaeger S., Moraga G., Dewulf J., De Meester S., Van Passel S., Compernelle T., Bachus K., Vrancken K., Eyckmans J.	2019	Conceptual paper	Belgium	Flanders (The Flemish region)	NUTS 1
Urban regions shifting to circular economy: Understanding challenges for new ways of governance	Obersteg A., Arlati A., Acke A., Berruti G., Czapiewski K., Dąbrowski M., Heurkens E., Mezei C., Palestino M.F., Varjú V., Wójcik M., Knieling J.	2019	Qualitative	The Netherlands, Italy, Belgium, Hungary, Poland, Germany	Urban regions (with their peri-urban areas) of Amsterdam, Naples, Ghent, Pécs, Łódź, Hamburg	The urban regions are not reflecting the NUTS boundaries of these cities, but can be considered as NUTS 1 and NUTS 2 regions based on the population
Transferring circular economy solutions across differentiated territories: Understanding and overcoming the barriers for knowledge transfer	Dąbrowski M., Varjú V., Amenta L.	2019	Qualitative	The Netherlands, Italy	Amsterdam Metropolitan Area, Naples Metropolitan Area	Can be considered as NUTS 2 and NUTS 1 regions respectively based on population

Circular area design or circular area functioning? A discourse-institutional analysis of circular area developments in Amsterdam and Utrecht, The Netherlands	Van den Berghe K., Vos M.	2019	Qualitative	The Netherlands	Circular Area Developments in Amsterdam and Utrecht	Amsterdam in this case is the city only and Utrecht is both NUTS 2 and NUTS 3 level, however the focus is on the circular area developments (Greenmills and Werkspoorkwartier)
Multi-criteria Evaluation of Bran Use to Promote Circularity in the Cereal Production Chain	Grippio V., Romano S., Vastola A.	2019	Mixed	Italy	Basilicata, Puglia	NUTS 2
An Integrated Material Flows, Stakeholders and Policies Approach to Identify and Exploit Regional Resource Potentials	Volk R., Müller R., Reinhardt J., Schultmann F.	2019	Mixed	Germany	Baden-Württemberg	NUTS 1
Circular economy strategies in eight historic port cities: Criteria and indicators towards a circular city assessment framework	Gravagnuolo A., Angrisano M., Girard L.F.	2019	Qualitative	The Netherlands, United Kingdom, Belgium, Germany, France, Portugal	Amsterdam, Rotterdam, London, Antwerp, Hamburg, Marseille, Lisbon, Porto	The authors are referring to the cities, but some of them (with their metropolitan areas) are also NUTS level regions
Circular economy indicators as a supporting tool for European regional development policies	Avdiushchenko A., Zajać P.	2019	Mixed	Poland	Malopolska	NUTS 2
Implementation at a city level of circular economy strategies and climate change mitigation – the case of Brussels	Christis M., Athanassiadis A., Vercalsteren A.	2019	Quantitative	Belgium	Brussels Capital Region (BCR)	BCR is NUTS 1, NUTS 2 and NUTS 3. According to the data used, the author is considering BCR as NUTS 1 region in this case

Bio-based circular economy in European national and regional strategies	Vanhamaki S., Medkova K., Malamakis A., Kontogianni S., Marisova E., Dellago D.H., Moussiopoulos N.	2019	Qualitative	Finland, Spain, Slovakia, Greece, Romania, France	National (see country cell) and regional: Päijät-Häme, Castilla-La Mancha, Nitra Region, Central Macedonia, South Muntenia region, Pays de la Loire	The regions are respectively: NUTS 3, NUTS 2, NUTS 3, NUTS 2, NUTS 2, NUTS 1/2
Role of waste collection efficiency in providing a cleaner rural environment	Mihai F.-C., Grozavu A.	2019	Quantitative	Romania	North-East region	NUTS 2
Toward a circular economy regional monitoring framework for European regions: Conceptual approach	Avdiushchenko A.	2018	Conceptual paper	N/A	NUTS 2 - proposed level of implementation	NUTS 2
Public awareness of circular economy in southern Poland: Case of the Malopolska region	Smol M., Avdiushchenko A., Kulczycka J., Nowaczek A.	2018	Qualitative	Poland	Malopolska	NUTS 2
Environmental taxes to promote the EU circular economy's strategy: Spain vs. Italy	Andretta A., D'Addato F., Serrano-Bernardo F., Zamorano M., Bonoli A.	2018	Qualitative	Spain, Italy	National, but some regional consideration for Autonomous Communities of Catalonia, Castile, and León	NUTS 2
Knowledge sharing and scientific cooperation in the design of research-based policies: The case of the circular economy	Marra A., Mazzocchitti M., Sarra A.	2018	Conceptual paper	N/A	The paper is general, though it has some marginal regional considerations	N/A
Company perspectives on the development of the CE in the seafaring sector and the Kainuu region in Finland	Husgafvel R., Linkosalmi L., Dahl O.	2018	Qualitative	Finland	Kainuu	NUTS 3

Forest sector circular economy development in Finland: A regional study on sustainability driven competitive advantage and an assessment of the potential for cascading recovered solid wood	Husgafvel R., Linkosalmi L., Hughes M., Kanerva J., Dahl O.	2018	Qualitative	Finland	Kymenlaakso	NUTS 3
Design for circular economy: Developing an action plan for Scotland	Whicher A., Harris C., Beverley K., Swiatek P.	2018	Qualitative	United Kingdom	Scotland	NUTS 1
Measurement of the circular economy in businesses: Impact and implications for regional policies	Aranda-Usón A., Moneva J.M., Portillo-Tarragona P., Llena-Macarulla F.	2018	Qualitative	Spain	Aragon	NUTS 2
Systemic design and policy making: The case of the RETRACE project	Barbero S., Pallaro A.	2018	Qualitative	Italy	Piedmont	NUTS 2
Enabling industrial symbiosis collaborations between SMEs from a regional perspective	Patricio J., Axelsson L., Blomé S., Rosado L.	2018	Mixed	Sweden	Västra Götaland	NUTS 3
Mind the gap: A model for the EU recycling target applied to the Spanish regions	Sastre S., Llopart J., Puig Ventosa I.	2018	Quantitative	Spain	Andalusia, Aragon, Asturias, Balearic Is., Basque C., C-La Mancha, C-Leon, Canary Is., Cantabria, Catalonia, Extremadura, Galicia, Madrid, Murcia, Navarre, Rioja, Valencia	NUTS 2, NUTS 2, NUTS 2/3, NUTS 2, NUTS 2, NUTS 2, NUTS 2, NUTS 2, NUTS 1/2, NUTS 2/3, NUTS 2, NUTS 2, NUTS 2, NUTS 1/2/3, NUTS 2/3, NUTS 2/3, NUTS 2/3, NUTS 2/3, NUTS 2/3
Towards a sustainable industrial ecology: Implementation of a novel approach in the performance evaluation of Italian regions	Arbolino R., De Simone L., Carlucci F., Yigitcanlar T., Ioppolo G.	2018	Quantitative	Italy	Tuscany, Piedmont, Lombardy, Marche, Veneto, Emilia-Romagna, Friuli-Venezia Giulia, Liguria, Lazio, Apulia, Trentino-Alto Adige,	NUTS 2

					Calabria, Campania, Basilicata, Umbria, Sardinia, Molise, Sicily, Abruzzo, Aosta Valley	
Non-technical barriers to (And drivers for) the circular economy through industrial symbiosis: A practical input	Lombardi R.	2017	Qualitative	N/A	The paper is general, though it has some marginal regional considerations	N/A
Industrial symbiosis, networking, and innovation: The potential role of innovation poles	Taddeo R., Simboli A., Ioppolo G., Morgante A.	2017	Qualitative	EU wide, Italy focus	Emilia Romagna, Liguria, Piedmont, Tuscany, Abruzzo, Lazio, Umbria	NUTS 2
Sustainable development: The circular economy indicators' selection model	Banaite D., Tamošiuniene R.	2016	Qualitative	N/A	The paper is general, though it has some marginal regional considerations	N/A
Local industrial systems towards the eco-industrial parks: The model of the ecologically equipped industrial areas	Taddeo R.	2016	Qualitative	Italy	Abruzzo, Calabria, Emilia Romagna, Liguria, Marche, Piedmont, Apulia, Sardinia, Tuscany	NUTS 2
Regional policies and eco-industrial development: The voluntary environmental certification scheme of the eco-industrial parks in Tuscany (Italy)	Daddi T., Iraldo F., Frey M., Gallo P., Gianfrate V.	2016	Qualitative	Italy	Tuscany	NUTS 2
Feasibility of Industrial Symbiosis in Italy as an Opportunity for Economic Development: Critical Success Factor Analysis, Impact and Constrains of the Specific Italian Regulations	Iacondini A., Mencherini U., Passarini F., Vassura I., Fanelli A., Cibotti P.	2015	Qualitative	Italy	Emilia-Romagna	NUTS 2

Eco-industrial parks development and integrated management challenges: Findings from Italy	Tessitore S., Daddi T., Iraldo F.	2015	Mixed	Italy	Tuscany, Emilia-Romagna, Veneto	NUTS 2 (EIPs mainly in these regions)
The experience of the first industrial symbiosis platform in Italy	Cutaia L., Luciano A., Barberio G., Scaffoni S., Mancuso E., Scagliarino C., La Monica M.	2015	Quantitative	Italy	Sicily	NUTS 2
The development of regional collaboration for resource efficiency: A network perspective on industrial symbiosis	Zhu J., Ruth M.	2014	Quantitative	Global (including EU wide)	Global IS Programmes mentioned	N/A
Industrial symbiosis networks and the contribution to environmental innovation: The case of the Landskrona industrial symbiosis programme	Mirata M., Emtairah T.	2005	Qualitative	Sweden	Landskrona	Based on population smaller than NUTS 3 - IS programme
Experiences from early stages of a national industrial symbiosis programme in the UK: Determinants and coordination challenges	Mirata M.	2004	Qualitative	United Kingdom	Humber region, West Midlands, Merseyside	NUTS 1, NUTS 1/2, NUTS 2 (IS programmes in these three regions)
Shared responsibility at the regional level: The building of sustainable industrial estates	Brand E., De Bruijn T.	1999	Qualitative	EU wide	General paper referring to EU territories and regions, though it uses the case of Kalundborg (Denmark - city -EIP), Rijnmond (Netherlands - city), Overijssel Province (Netherlands)	Kalundborg considered smaller than NUTS 3 based on population, Rijnmond NUTS 3 and Overijssel is NUTS 2

Appendix B: Policy analysis

Author(s)/Level of Policy	EU/International	National	Regional	Local
Towa et al. (2021)				
Yu et al. (2021)				
Stanojev and Gustafsson (2021)	1.EU Cohesion Policy for 2014–2020 2.CE Action Plan 3.EU Green Deal 4.Multiannual Financial Framework (MFF) 2021–2027			
Ortega Alvarado et al. (2021)	1.EU CE Policy Package	1.Waste as resource –Waste politic and CE	1.The strategy for innovation and value creation in Trøndelag 2.The waste management plan for Trondheim Municipality 2018 – 2030 3.Trondheim Municipality’s plan for energy and climate 4.Climate strategy for the County	
Kaya et al. (2021)	1.EU CE Action Plan 2.The European Framework for Action on Cultural Heritage 3.Urban Agenda for the EU 4.Pact of Amsterdam 5.Cohesion Policy			
Vanhamäki et al. (2021)	1.S3 strategies 2.Closing the Loop— An EU Action Plan for the CE 3.A new CE Action Plan 4.European Green Deal Investment Plan 5.Europe 2020 strategy			

Sani et al. (2021)	1.European Green Deal 2.EU Bioeconomy strategy 3.EU CE Action Plan 4.Directive (EU) 2018/8497 5.2000/53/EC Directives Relating to End-of-Life Vehicles 6.2006/66/EC Relating to Batteries and Accumulators and to Waste Batteries and Accumulators 7.2012/19/EU on Waste Electrical and Electronic Equipment. 8.Directive (EU) 2018/850 9.Directive 1999/31/EC on Landfills of Waste 10.Directive (EU) 2018/851 11.Directive 2008/98/EC on Waste 12.Directive (EU) 2018/852 13.Directive 94/62/EC on Packaging and Packaging Waste	1.Bioeconomy Strategy in 2017 2.A new Bioeconomy strategy for a sustainable Italy 3.Implementation action plan -2020-2025- for the Italian bioeconomy strategy 4. National Industry 4.0 Plan 5.Towards a Circular Economy model for Italy: Overview and Strategic Framework 6. Law 221 of 28 December 2015, containing "Environmental Provisions to Promote Green Economy Measures and for the Containment of Excessive Use of Natural Resources	1.Regional Programme for CE (PREC—Programme Régional en Economie Circulaire) 2.2014–2020 Operational Programme of ERDF 3.Regional Smart Specialisation Strategy 4. Regional Law n. 16 5. regional law 19 August 1996 n. 31 6. Regional Waste Plan of Emilia-Romagna Region	
Henrysson and Nuur (2021)	1.EU CE Action Plan	1.Sweden’s CE National Strategy	1.Paijat-Hameen CE strategy 2.Brussels Capital Region CE strategy 3.Malopolska CE strategy 4.Extramadura CE strategy	
Towa et al. (2021a)	1.EU CE Action Plan			
Sutcliffe and Ortega Alvarado (2021)	1.Closing the Loop’ (2015) 2.New CE Action Plan (2020) 3.The European Green Deal	1.Waste as resource – waste politics and circular economy (2016-2017) 2.Political platform Granavolden	1.Strategy for innovation and value creation in Trøndelag (2017) 2.Action programme 2018–2019 to the innovation and value creation strategy 3.Action programme 2020–2021 to the innovation and value creation strategy	1.Waste management plan for Trondheim municipality 2018–2030 2.Energy and climate plan for Trondheim municipality (2017–2030)

Gonçalves et al. (2021)		
Towa et al. (2021b)		
Lechner et al. (2021)	1.EU's Eco-design Directive	
Boffardi et al. (2021)	1.CE Package 2.EU Directives 2018/850 and 851 3.Landfill Directive 4.Waste Framework Directive (2008/98/EC) 5.CE Action Plan	1. Regional Plan for Urban Waste Management
Tazi et al. (2021)	1.Waste framework directive 2008/98/EC	
Ingstrup et al. (2021)		
Poponi et al. (2020)	1.Smart Specialisation Strategy 2.Circular Economy Package 3.EU action plan for the Circular Economy 4.EU Framework Program for Research and Innovation research Horizon 2020	
D'Adamo et al. (2020)	1.EU Bioeconomy Strategy 2.2030 Agenda 3.SDGs 4.Industrial Policy Strategy 5.CE Action Plan 6.Communication on Accelerating Clean Energy Innovation	
Agovino et al. (2020)	1.Directive 2008/98/EC 2.European Regional Policy 3.Regional Development Fund Regulation (ERDF) (EC) No 1783/1999 4.Regulation (EC) No 1080/2006	1.Legislative Decree 205/2010 2. Legislative Degree 152/06

Compagnoni (2020)	<ol style="list-style-type: none"> 1.EU CE Action Plan 2.Cohesion policy 3.Waste Framework Directive 4.Waste Hierarchy 5.CE package, 6.EC Directive, 1994 7.EC Directive, 1999 8.EC Directive, 2003 9.EC Directive, 2006 10.EC Directive, 2008 11.EC Directive, 2012 12.European Green Deal 13.United Nation's 2030 Agenda 14.SGDs 15.Smart Specialisation Strategies 	<ol style="list-style-type: none"> 1.Measures in support of the circular economy, of urban waste prevention, reuse, differentiated collection and RL 19/10/1996 2.Rilancimpresa FVG" – industrial policies reform, Venezia Giulia Region 3.Regional Law 34/2017 Waste management regulation and principles of circular economy 4.Integrated waste management norms and polluted areas decontamination, Umbria Region 5.Industry 4.0: innovation, research and education, Marche Region 6.Norms in implementation of part IV D. Lgs. 3 April 2006, n. 152, on waste management and polluted areas decontamination, Basilicata Region
Cappellaro et al. (2020)	<ol style="list-style-type: none"> 1.European CE Package 2.European Waste Framework Directive 3.CE Action Plan 	<ol style="list-style-type: none"> 1.EM Regional Law on CE n. 16 2.Waste Management Plan (WMP)
Arbolino et al. (2020)	<ol style="list-style-type: none"> 1.ISO14001 certification 	
Savini and Giezen (2020)	<ol style="list-style-type: none"> 1.Netherlands Circular 2015, 'climate policy package' (Klimaatakkord), 	

Cramer (2020)		1. A Circular Economy in the Netherlands by 2050: Government-wide Programme for a Circular Economy 2. Uitvoeringsprogramma Circulaire Economie (Execution programme Circular Economy) 2019–2023	1. Towards Circular Region Utrecht' ('Op weg naar Cirkelregio Utrecht') 2. Circular Friesland
Nohra et al. (2020)	1. EU CE package 2. Smart Specialisation Strategies (EU N° 1303/2013) 3. EU Bioeconomy Strategy 4. EU Plastics Strategy		
Silvestri et al. (2020)	1. Cohesion policy	1. Basic Law for Establishing a Recycling-Based Society 2. Circular Economy Promotion Law 3. Closed Substance Cycle and Waste Management Act	
Vanhamäki et al. (2020)	1. Directive 1999/31/EC	1. Finland's road map to a circular economy 2016–2025 2. 331/2013/Finnish State Council	1. Päijät-Häme road map towards CE 2. Circular Amsterdam (2016), 3. Circular Glasgow (2016) 4. London CE Route Map
Alonso-Almeida and Rodríguez-Antón (2020)	1. Roadmap to a resource efficient Europe 2. Closing the loop. An EU action plan for CE 3. Next steps for a sustainable European future: European action for sustainability 4. Key European action supporting the 2030 Agenda and the SDGs 5. Monitoring framework for the CE 6. A European strategy for plastics in a CE 7. Directive (UE) 2018/849 8. Directive (UE) 2018/850 9. Directive (UE) 2018/851		

	<p>10.Directive (UE) 2018/852</p> <p>11.A sustainable bioeconomy for Europe: Strengthening the connection between economy, society, and the environment</p> <p>12. Towards a sustainable Europe by 2030</p> <p>13. The implementation of the CE action plan</p> <p>14.Environmental implementation review 2019: A Europe that protects its citizens and enhances their quality of life</p> <p>15.United in delivering the energy union and climate action. Setting the foundations for a successful clean energy transition</p> <p>16.The European green deal</p> <p>17.Annual sustainable growth strategy 2020</p>		
Sánchez Levoso et al. (2020)		<p>1.Circular Amsterdam: A vision and action agenda for the city and the Amsterdam</p> <p>2.Circular Glasgow: A vision and action plan for the city of Glasgow</p> <p>3.London, the CE Capital: Towards a CE - context and opportunities</p> <p>4.White Paper on the CE of Greater Paris</p>	<p>1.Roadmap, CE Rotterdam</p> <p>2.CE Strategy and Vision for Ambit B30</p> <p>3.Promotion Plan for Local CE in Mataro</p>
Aranda-Usón et al. (2020)			
Santagata et al. (2020)	1.EU CE Package		

Real et al. (2020)			
Drejerska et al. (2020)			
Bianchi et al. (2020)			
Banias et al. (2020)	1.Waste Framework 2.Landfill Directive 3.ISO 14044 standards	1.Greek National Waste Management Plan	1.Regional Waste Management Plan (RWMP)
Gardiner R., Hajek P.	1.7th Environmental Action Plan (EAP)		
Kokkinos et al. (2020)		1.National Renewable Action Plan	
Amenta and Qu (2020)			
Patricio et al. (2020)	1.EU CE Package 2.EC No 2150/ 2002	1.Portuguese regulation Decree-Law nº 73/2011	
Foschi et al. (2020)	1.Directive 2008/98/EC 2.A European Strategy for Plastics 3.Waste Framework Directive (WFD), 4.EU CE Package	1.Consolidated Environmental Law 2.Legislative Decree 152/06, 3.Decision 2011/753/UE 4.Directive 2018/851/UE	
Cossu et al. (2020)	1.Kyoto Protocol (1997) 2.European Directive 1999/31/EC	1.Law nº 36/2003	1.Guidelines for Sustainable Design and Management of Landfills
Scarpellini et al. (2019)			
	1.Towards a Circular Economy: A Zero Waste Programme for Europe 2.Closing the Loop: An EU Action Plan for the Circular Economy 3.BREF (European Directive 2010/75/EU) 4.EU Waste Framework Directive		
Bezama et al. (2019)	1. Innovating for Sustainable Growth: A Bioeconomy for Europe	1.BioEconomy 2030—Our Route towards a Biobased Economy 2. National Policy Strategy on Bioeconomy. Renewable Resources	

and Biotechnological Processes as a Basis for Food, Industry and Energy				
Agovino et al. (2019)	1.2008/98/EC Waste Directive 2.EU CE Package 3.EC No 1783/1999 4.EC No 1080/2006			
Paletta et al. (2019)	1. European Strategy for Plastics in a Circular Economy 2.Directive 2008/98/EC 3.REACH Regulation that sets out criteria for classifying a substance as a 'substance of very high concern' (SVHC) 4.RoHS Directive that regulates the presence of Lead, Mercury, Cadmium, Hexavalent chromium, Polybrominated biphenyls (PBB) and Polybrominated diphenyl ethers (PBDE) in products 5.Regulation (EC) n. 1935/ 2004 6.Regulation (EC) 282/2008 7.Regulation (EU) n. 10/2011 8.Directive on waste (Directive 2018/851/EU) 9.Directive on packaging and packaging waste (Directive 2018/852/EU) 10.Statistical classification of economic activities in the EU Community (NACE)	1.Chinese import ban		
Savini (2019)		1.Netherlands Circular 2050 2.From Waste to Resource (VANG, van Afval naar Grondstof) 3.Climate Agreement (Klimaatakkord)	1.Circular Amsterdam: A vision and action agenda for the city and metropolitan area	1.Be-Circular Brussels redevelopment plan 2.Paris Circular Economy Plan for valorising waste 3.2011 Amsterdam Integraal Duurzaam

		4.Green Deal for Netherlands Hotspot for Circular Economy 5.Grondstoffennotitie	
Virtanen et al. (2019)	1.The European Union's Waste Directive	1.Government Decree for landfill disposal of organic waste 2.Finnish Waste Tax Act 3.National landfill ban on organic waste	1.Paijat-Hame Road Map Towards Circular Economy
Alaerts et al. (2019)	1.Sustainable Development Goals 2.EU Waste Framework Directive		
Obersteg et al. (2019)	1.The EU Circular Economy Strategy 2017	1.The Circular Economy Act (Kreislaufwirtschaftsgesetz) 2.Polish waste regulation from 2012 (amended in 2015) 3.Polish Act of 1996 on maintaining cleanliness and order in municipalities (amended in 2011 and 2014)	1.Circular Amsterdam: A vision and action agenda for the city and metropolitan area
Dąbrowski et al. (2019)			
Van den Berghe and Vos (2019)	1.Directive 2001/77/EC Renewable Energy 2.Directive 2003/30/EC Biofuels 3.Directive 2008/98 EC Waste 4.Directive 2009/28/EC Renewable energy 5.Manifesto for A resource efficient Europe 6.Policy recommendation for a resource efficient Europe 7.Circular Economy Action Plan 8.Directive Proposal 2018/04-11 Waste 9.Directive: 2018/849-852 Waste	1.Circular Economy: from wish to practice 2.Working towards a CE: no time to lose 3.Netherlands Circular in 2050 4.National Agreement on the CE 5.Presentation transition agendas CE 6.Vision Circular Agriculture	1.Port vision 2008-2020 focused on bio 2.Amsterdam Circular: Roadmap & vision 3.Port vision 2015-2030 focus bio and CE 4.Research redevelopment Werkspoor-factory 5.Development vision Werkspoorkwartier 6.Decision to transform adjacent industry area to housing 7.Decision phasing out of gas fired elect. plant in 2022

Grippo et al. (2019)	1.European Commission (EC). (2005). Taking sustainable use of resources forward: A thematic strategy on the prevention and recycling of waste 2.European Commission (EC). (2011). Analysis associated with the Roadmap to a Resource Efficient Europe Part II 3.European Union (EU) (2013). On a General Union Environment Action Programme to 2020 Living well, within the limits of our planet Decision no 1386/2013/EU of the European parliament and of the council 4.European Union (EU). (2018). Circular economy package. Four legislative proposals on waste			
Volk et al. (2019)	1.Closing the loop - An EU action plan for the Circular Economy, European Commission, 2014 2.Living Well, within the Limits of our Planet: 7th EAP - the New General Union Environment Action Programme to 2020			
Gravagnuolo et al. (2019)	1.New Urban Agenda 2.Sustainable Development Goals 3.Towards a circular economy: A zero waste programme for Europe 4.Closing the loop – An EU action plan for the circular economy 5.Urban Agenda for the EU: Pact of Amsterdam 6.Territorial Agenda (post 2020)	1.Closed Substance Cycle and Waste Management Act 2.Basic Law for the Promotion of the Creation of a Recycling-Oriented Society in 2001 3.Circular Economy Promotion Law of the People's Republic of China 4.A Circular Economy in the Netherlands by 2050	1.Making Things Last: A Circular Economy Strategy for Scotland 2.Strategy of the Government of Catalonia: Promoting Green and Circular Economy in Catalonia 3.Brussels Regional Programme for Circular Economy 4.Paijat Hame Roadmap Towards a Circular Economy	1.Strategy for the Transition to Circular Economy in the Municipality of Maribor 2.Roubaix's Circular Economy Route Map

		<p>5. Leading the Cycle—Finnish Road Map to a Circular Economy 2016–2025</p> <p>6. The German Resource Efficiency Programme II: Programme for the Sustainable Use and Conservation of Natural Resources</p> <p>7. Towards a Model of Circular Economy for Italy—Overview and Strategic Framework</p> <p>8. Leading the Transition: A Circular Economy Action Plan for Portugal</p> <p>9. National Action Plan on Circular Economy – Greece</p> <p>10. Luxembourg’s National Waste and Resource Management Plan</p> <p>11. Circular Economy Roadmap of France: 50 Measures for a 100% circular economy</p> <p>12. Roadmap towards the Circular Economy in Slovenia</p>	<p>5. Extramadura 2030-Regional Government of Extremadura</p> <p>6. Circular Flanders Kick-off Statement</p> <p>7. London's Circular Economy Route Map</p> <p>8. Circular Hague: Transition to a Sustainable Economy</p>
Avdiushchenko and Zajač (2019)	<p>1. 2030 Sustainable Agenda</p> <p>2. Paris Agreement</p> <p>3. Towards a circular economy: A zero-waste program for Europe</p> <p>4. Closing the loop-An EU action plan for the Circular Economy</p> <p>5. EUROPE 2020</p> <p>6. Sustainable Development Strategy (from 2005 to 2015)</p> <p>7. Sustainable Development Goals (since 2016)</p> <p>8. European Pillars of Social Right</p>	<p>1. A Circular Economy in the Netherlands by 2050</p> <p>2. Leading the Cycle Finnish Road Map to a Circular Economy 2016–2025</p> <p>3. Germany-German Resource Efficiency Programme (ProgRess II)</p> <p>4. Leading the Transition: A Circular Economy Action Plan for Portugal: 2017–2020</p> <p>5. Towards a Model of Circular Economy for Italy—Overview and Strategic Framework</p> <p>6. France Unveils Circular Economy Roadmap</p>	<p>1. Circular, Promoting Green and Circular Economy in Catalonia: Strategy of the Government of Catalonia</p> <p>2. Programme Régional En Economie Circulaire 2016–2020</p> <p>3. A Circular Economy Strategy for Scotland Report</p> <p>4. Circular Amsterdam: A vision and Action Agenda for the City and Metropolitan Area</p> <p>5. White Paper on the Circular Economy of the Greater Paris</p>

		7.Roadmap towards the Circular Economy in Slovenia	6.Extremadura 2030: Strategy for a Green and Circular Economy 7.London's Circular Economy Route Map 8.Circular Flanders Kick-off Statement. Vlaanderen Circulair, 9.Waste Management Plan of Malopolska 10.Spatial Management Plan for the Malopolska Region
Christis et al. (2019)	1.Paris Agreement		
Vanhamaki et al. (2019)	1.Bioeconomy Strategy of the EC EU CE package 3.Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on Waste and repealing Certain Directives 4.Europe 2020 Strategy concerning a resource-efficient Europe	2. 1.Greek National Plan for Waste management 2.The Finnish roadmap to a Circular economy 2016–2025 3.Waste management State Plan Pemar 2016–2020 (Spain) 4.The Waste management Program of the Slovak republic 2016–2020 5.Law relative for energy Transition for green growth act 2015–2030 (France) 6.Romanian National Waste Management Strategy 2014–2020 7.Circular Spain 2030: Spanish strategy for CE 8.Greener Slovakia - strategy of the Environmental policy of the Slovak republic until 2030 9.Greek national CE plan 10.French national CE roadmap	1.Päijät-häme regional Strategy and program 2018–2021 2.Päijät-häme road map: Towards Circular economy in Finland 3.Integrated waste management plan of Castilla-la Mancha 2016 4.Smart Specialisation Strategy of South Muntenia region 2015 5.Performance agreement for a regional Dynamic about Waste and Circular economy (CODreC) 2016–2018. Pays de la Loire region 6.Program of economic and Social Development of Nitra region in Slovakia 2016 7.Waste management Plan of Central Macedonia 2016
Mihai and Grozavu (2019)	1.Landfill Directive 1999/31/EC	1. Government Decision no. 345 2.National Waste Management Plan	

Avdiushchenko (2018)	<ol style="list-style-type: none"> 1.SDGs 2.EU Cohesion Policy for 2014–2020 3.Towards a circular economy: A zero waste programme for Europe 4.Urban Agenda for the EU (Pact of Amsterdam) 5.Circular Economy Promotion Law, 6.11th Five-Year Plan in China 7.12th Five-Year Plan in China 8.13th Five-Year Plans in China 9.Directive 2008/98/EC on waste 10.Europe 2020 Strategy for Smart, Sustainable, and Inclusive Growth for 2014–2020 11.EU circular economy Action Plan 	<ol style="list-style-type: none"> 1.A circular economy in the Netherlands by 2050 2.Finland’s National Circular Economy Roadmap 3.ProgRess II—German Resource Efficiency Programme 4.Leading the transition: a circular economy action plan for Portugal 5.Towards a Model of Circular Economy for Italy—Overview and Strategic Framework 6.France Unveils Circular Economy Roadmap 7.Roadmap towards the Circular Economy in Slovenia 	<ol style="list-style-type: none"> 1.Catalonia’s Promoting Green and Circular Economy in Catalonia: Strategy of the Government of Catalonia 2.the Brussels Region’s Programme Régional en Economie Circulaire (2016) 3.Scotland’s Making Things Last: A Circular Economy Strategy for Scotland 4.Amsterdam’s Circular Amsterdam 5.Paris’ White Paper on the Circular Economy of Greater Paris 6.Extremadura’s Extremadura 2030: Strategy for a Green and Circular Economy 7.London’s Circular Economy Route Map 8.Flanders’ Circular Flanders kick-off statement (Vlaanderen Circulair, 2017)
Smol et al. (2018)	<ol style="list-style-type: none"> 1.Towards a circular economy: A zero waste programme for Europe (COM no. 398, 2014) 2.Closing the loop - An EU action plan for the Circular Economy 3.Europe 2020 Strategy 	<ol style="list-style-type: none"> 1.A Circular Economy in the Netherlands by 2050 2.Act on Waste (Journal of Laws, 2013, item. 21) 3.Polish roadmap Transformation towards a circular economy 	<ol style="list-style-type: none"> 1.Waste Management Plan for Malopolska 2.Spatial Management Plan for the Malopolska Region
Andretta et al. (2018)	<ol style="list-style-type: none"> 1.EU package on CE 2.Waste Framework Directive (EC Directive, 2006) 3. Waste Framework Directive (EU EC Directive, 2008) 		

Marra et al. (2018)	<ul style="list-style-type: none"> 1.Closing the loop - An EU action plan for the Circular Economy 2.European Better Regulation Guidelines 3.European Better Regulation Toolbox 	
Husgafvel et al. (2018)	<ul style="list-style-type: none"> 1.EU CE Strategy 2.EU CE Action Plan 	
Husgafvel et al. (2018a)	<ul style="list-style-type: none"> 1.EU circular economy strategy 2.EU CE Action Plan 3.EU Bioeconomy strategy 4.A Resource-efficient Europe e Flagship Initiative under the Europe 2020 Strategy 	1.Finnish bioeconomy strategy
Whicher et al. (2018)	<ul style="list-style-type: none"> 1.EU Circular Economy Action Plan 2.Environmental Action Programme of 'living well within the limits of the planet' by 2050 3.Sustainable Development Goals 4.Action Plan for Design-Driven Innovation 5.Ecodesign Directive (2009) 6.Eco-Innovation Action Plan (2011) 7.Roadmap to Resource Efficient Europe 8.Ecolabeling 9.7th Environmental Action Programme 2020 	<ul style="list-style-type: none"> 1.Zero Waste Scotland 2.Chemicals Sector Strategic Plan 3.the Technology and Engineering Sector's 'A Framework for Action' 4.the construction industry document 'Building for the Future
Aranda-Usón et al. (2018)	<ul style="list-style-type: none"> 1.Towards a circular economy: A zero waste programme for Europe 2.Closing the loop: An EU action plan for the circular economy 3.The role of waste-to-energy in the circular economy COM (2017) 4.A European Strategy for Plastics in a Circular Economy COM (2018) 	<ul style="list-style-type: none"> 1.Circular Economy Act – China 2.National Strategy for the Promotion of Circular Economy for 2030

	5.EU-Report on Critical Raw Materials and the Circular Economy	
Barbero and Pallaro (2018)	1.EU CE action Plan 2.Flagship Initiative for a Resource-efficient Europe 3.Europe 2020 strategy 4.Towards a Circular Economy: A Zero Waste Programme for Europe	
Patricio et al. (2018)		
Sastre et al. (2018)	1.European Directive 2008/98/EC 2.Waste Framework Directive 3.Directive 2018/851 4.EUCE Package 2015, 5.Commission Decision 2011/753/EU	1.Spanish National Waste Management Plan
Arbolino et al. (2018)	1.European Strategy 2020 2.Plan of Government Industry 4.0	
Lombardi (2017)	1.Towards a circular economy: a zero-waste programme for Europe (COM/2014/0398) 2.2015 CE Package 3.Closing the loop – An EU action plan for the Circular Economy (COM/2015/0614) 4.Roadmap to a Resource Efficient Europe (COM/2011/571) 5.Connecting Smart and Sustainable Growth through Smart Specialisation 6.EU Waste Framework Directive 7.EU’s 2008 Raw Materials Initiative (COM/2008/699) 8.Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan (COM/2008/397)	

	9.Industrial Emissions Directive 10.Basel Convention 11.Waste Framework Directive 12.Sustainable Development Goals	
Taddeo et al. (2017)		1.Abruzzo - Resolution No. 248 2.Calabria - Resolution No. 194 3.Emilia Romagna - Resolution No. 736 4.Lazio - Resolution No. 611 5.Liguria - Resolution No. 177 6.Piedmont - Resolution No. 25-8735 7.Tuscany - Resolution No. 1040 8.Umbria - Resolution No. 226 9.Regional Law No. 16 10.Regional Law No. 20
Banaite and Tamošiuniene (2016)	1.Our Common Future 2.Circular Economy Package 3.EU Action Plan for the Circular Economy 4.Treaty of Amsterdam in 1999 5.Roadmap to a Resource Efficient Europe	
Taddeo (2016)	1.Italian Legislative Decree 112/98	1.Abruzzo Resolution No.1122 2. Calabria Regional Law No.38 3.Emilia Romagna Resolution No.118 4.Liguria Resolution No.1486 5.Marche Resolution No.157 6.Piedmont Resolution No.30 7.Apulia Regional Law No.2 8.Sardinia Resolution No.4/2 9.Tuscany Resolution No.1245

Daddi et al. (2016)	1. ISO14001	1. Italian national law (decree 112/98)	1. Tuscan Regulation 74/2009 2. Resolution 1245/2009 3. Regional Environmental and Energy Plan 4. Regulation 1221/2009 (EMAS)
Iacondini et al. (2015)	1. European Cohesion Policy 2. Horizon 2020 Environment and Climate Action 3. Directive 2008/98/EC	1. D.lgs. 156/06 2. D.lgs. n. 205/2010	1. Smart Specialisation Strategy (S3)—Emilia-Romagna Regional Policies 2. Waste Management Regional Plan 3. POR FESR Regional Strategic Framework
Tessitore et al. (2015)		1. Legislative Decree 112/1998	1. Regulation n. 74/2009 (Regolamento in materia di Aree produttive ecologicamente attrezzate APEA) 2. Regional Decree 1245/2009 (Criteri per la definizione delle prestazioni ambientali delle Aree produttive ecologicamente attrezzate—APEA)
Cutaia et al. (2015)	1. Directive 75/442 / EC		
Zhu and Ruth (2014)		1. Basic Law for Establishing a Recycling-Based Society 2. National Demonstration EIP Program 3. CE Promotion Law	
Mirata and Emtairah (2005)			
Mirata (2004)			
Brand and De Bruijn (1999)	1.5 th Environmental Action Programme		

Appendix C: Regional policy experts for policy Delphi study

Country	Region	Department/Organisation	Respondent (initial used for confidentiality)	Survey	Interview	Policy Brief
Austria	Upper Austria	Business Upper Austria - OÖ. Wirtschaftsagentur GmbH	KO, Head of Policy and location strategy	✓		
			CM, Project Manager for Circular Economy	✓	✓	
Belgium	Brussels Capital Region	ICLEI European Secretariat	HOP, Circular Economy and Public Procurement Officer	✓		
		Former European Commission	DC, Former senior official (Head of Unit)	✓	✓	✓
		CEPS	VR, Head of Sustainable Resources	✓	✓	✓
	Flanders	Departement Landbouw & Visserij, Vlaamse overheid,	DV, Policy Advisor	✓		
	Wallonia	Public Service of Wallonia	FH, Senior Advisor	✓		
Cyprus	Cyprus	Cyprus Employers and Industrialists Federation	PK, Officer	✓		
Czech Republic	Prague	Institute of circular economy Czech Republic	SKJ, CEO	✓		
Denmark	Capital Region	The Capital Region of Denmark - regional development	HM, Chief Consultant	✓		
	Central Jutland Regions (The Central Denmark Region)	Central Denmark Region	RJ, Head of department	✓		
			HJ, Development Consultant - Circular Economy Beyond Waste		✓	
Finland	East and North Finland	East and North Finland EU Office	TT, EU Advisor	✓		
	West Finland	Regional Council of South Ostrobothnia	AS, Innovation Director	✓		
France	Pays de la Loire	Pays de la Loire Europe	AL, Policy Officer	✓		
Germany	Weser-Ems	MCON Dieter Meyer Consulting GmbH	DM, Consultant	✓		
Greece		Region of Central Macedonia	MG,	✓		

	Region of Central Macedonia		Head of Innovation Support Department MC, Director of Innovation and Entrepreneurship Support	✓		
		Regional Development Fund of Central Macedonia	CK, Head of Department	✓	✓	✓
	Western Macedonia	University of Western Macedonia	GM, Professor	✓		
		Cluster of Bioeconomy and Environment of West Macedonia	IF, Director	✓	✓	
	West Greece	Regional Authority West Greece	NT, Head of Unit B (Project Implementation), Managing Authority for ERDF + ESF + CF Projects, Region West Greece	✓		
	Eastern Macedonia and Thrace	Managing Authority of Eastern Macedonia and Thrace Region	IK, Officer	✓		
	N/A	UN SDSN Greece and EIT Climate-KIC Hub Greece	LP, Manager		✓	
Hungary	North Great Plain Region	Innova North Great Plain Innovation Agency Non-profit Llc.	GV, General manager	✓		
Italy	Emilia-Romagna Region	Region Emilia-Romagna	VC, Waste Management Technician	✓		
	Tuscany	Region Toscana	SV, Official	✓		
		Tuscany Region Brussels Office	FB, Policy Advisor	✓		
	Marche Region	Marche Agriculture Fisheries - Agency for Innovation in the Agri-food and Fisheries sector	CF, EU Project Manager	✓	✓	
Lithuania	Capital Region	Lithuanian innovation centre	JRH, Project manager	✓		
Luxembourg	Luxembourg	Ministry of economic affairs	PC, Head of ERDF Managing authority	✓		

		Ministry of Energy and Spatial Planning	PS, Director for Sustainable Construction and Circular Economy	✓		
Poland	Malopolskie	Mineral and Energy Economy Research Institute of the Polish Academy of Sciences	MS, Head of division / Professor	✓	✓	
Portugal	Madeira	ARDITI	PA, Project Manager	✓		
Romania	North-East Region	North-East Regional Development Agency	SP, Expert, RIS3 North-East (Environment RIS3 domain)	✓		
			AF, (Head of Sectorial Specialisation Office Communication, Innovation and External Cooperation Department)			✓
Slovakia	Western Slovakia	Ministry of Investments, Regional Development and Informatisation of the Slovak Republic	MM, General State Counsellor	✓	✓	✓
Spain	Galicia	Universidad de Vigo	MR, Associate Professor	✓	✓	
	Basque Country	Basque Government	LE, EU Policy Officer	✓		
	Catalonia	Government of Catalonia	TF, Head of Economic Strategy, responsible for the coordination of Catalonia's S3	✓	✓	
			I, Policy Officer	✓		
Sweden	Stockholm	Region Stockholm	EL, Climate strategist	✓		
The Netherlands	Friesland	Circular Friesland Association	MDB, Project member	✓		
	South Holland	Province Zuid-Holland	MH, Policy Officer	✓		
			AVDS, Strategist – Circular Transition		✓	✓

			RT, Programme manager Circular South Holland	✓	
	Holland	Holland Circular Hotspot	LP, Secretary and Program Manager	✓	✓
United Kingdom	N/A	Alliance Manchester Business School	PMC, Professor and Special Adviser to two EU Commissioners for Regional Policy, engaged with JRC Seville	✓	✓
Philippines	N/A	De La Salle University, United Nations Environment Programme – International Resource Panel (UNEP-IRP)	AC, Professor, Panel Member of UNEP-IRP	✓	✓
EU institutions	N/A	European Committee of the Regions (CoR)	TW, Director for Legislative Works (Regional Policy, Economic Affairs, Employment and Innovation)	✓	
		Circular Cities and Regions Initiative (CCRI), European Commission; ERRIN	AH, Policy and Project Manager at ERRIN, Community Manager of CCRI	✓	✓
		Joint Research Centre (JRC) Seville, European Commission	DP, Economist at the Territorial Development Unit of the Directorate for Growth and Innovation	✓	

Appendix D: Survey for policy Delphi study

Implementing Circular Economy at a regional level

Invitation paragraph

Dear Participant,

This survey is part of a PhD project which aims to investigate whether Smart Specialisation Strategies (S3) influence the adoption of Circular Economy (CE) policies at the regional level.

We are inviting regional policy experts from different organisations and public administration that made some attempts towards CE implementation.

The participation in this research is completely voluntary and you have the right to withdraw at any point without explanation. If you do decide to take part, you will be asked to read and agree to the consent form, before proceeding to the survey. Considering the importance and the attention of the CE concept, this research will be beneficial to all regional level stakeholders and organisations who aim to make efforts in implementing relevant policies for CE transition. Hence, your participation will be highly valuable and appreciated.

Data confidentiality

All the information that we collect about you during the course of the research will be kept strictly confidential and anonymised. These anonymised data will not allow any individuals or their organisations to be identified or identifiable. Any data collected about you will be stored online in an encrypted form on a password protected University of Sheffield database.

Funding and ethical grounds of the project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie-Sklodowska-Curie innovative Training Networks (H2020-MSCA-ITN-2018) scheme, grant agreement number 814247 (ReTraCE).

The University of Sheffield, Management School will act as the Data Controller for this study. This means that the University of Sheffield, Management School is responsible for looking after your information and using it properly. This project has been ethically reviewed and approved through the University of Sheffield's Ethics Review Procedure, as administered by the guidance provided by the Management School.

Complaints procedure

In case something goes wrong, and you would like to raise a complaint that is related on the way the data collection is handled, or the treatment by the lead researcher you should contacts the researcher's supervisory team – Andrea Genovese (a.genovese@sheffield.ac.uk) and Prof. Panayiotis H. Ketikidis (ketikidis@york.citycollege.eu). However, if you feel that the complaint has not been

handled properly by the supervisory team you, or in case of something serious occurs in terms of the management of the data by the researcher then you should contact Prof. Rachel Finn (r.l.finn@sheffield.ac.uk) or Sophie May (s.may@sheffield.ac.uk) from the University of Sheffield, and Prof George Eleftherakis (g.eleftherakis@sheffield.ac.uk) from the South-East European Research Centre (SEERC).

Project contact details for further information:

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Tel: +30 698 6827639, email: asanja@seerc.org | sarsova1@sheffield.ac.uk

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Tel: +44 (0)114 222 3347, email: a.genovese@sheffield.ac.uk

Prof. Panayiotis H. Ketikidis, South-East European Research Centre, Thessaloniki, Greece.

Tel: +30 2310 253477, email: ketikidis@york.citycollege.eu

Participant Consent Form

To proceed with survey completion please read carefully the following statements and select the appropriate answers:

	Yes	No
I confirm that I have read and understood the terms and condition for participation in the study.	<input type="radio"/>	<input type="radio"/>
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason and with no foreseeable consequences.	<input type="radio"/>	<input type="radio"/>
I agree to take part in this survey.	<input type="radio"/>	<input type="radio"/>
I understand and agree that my words may be quoted in publications, reports, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this.	<input type="radio"/>	<input type="radio"/>
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield.	<input type="radio"/>	<input type="radio"/>

Section A: Background information

Name of Participant:

Name of Institution:

Position in the Institution:

Name of the NUTS 2 region:

Does your NUTS 2 region have a Circular Economy policy (strategy/action plan)?

- ☐ Yes
- ☐ No
- ☐ I don't know

Please insert the link to the Circular Economy policy

In which stage of Circular Economy adoption, you consider your region to be:

- ☐ In development
- ☐ In place, partly implemented
- ☐ In place, functioning
- ☐ In place, all objectives achieved

Section B: Smart Specialisation Strategies (S3)

In the context of Smart Specialisation Strategies (S3), which category does your region belong?

- ☐ Had S3 for the 2014-2020 programming period
- ☐ Has S3 for the 2021-2027 programming period
- ☐ Has S3 for the two programming periods
- ☐ Has no S3 for any of the programming periods
- ☐ Other (please explain) _____

Is Circular Economy selected as Smart Specialisation Strategies (S3) priority in your region?

- ☐ Yes, for the 2014-2020 programming period
- ☐ Yes, for the 2021-2027 programming period
- ☐ Yes, for the two programming periods
- ☐ No
- ☐ I don't know

Please choose the year when it was first selected:

- ☐ 2014
- ☐ 2015
- ☐ 2016
- ☐ 2017
- ☐ 2018
- ☐ 2019
- ☐ 2020
- ☐ 2021
- ☐ 2022

Please briefly state the reason(s) why it was selected:

What do you think is the direction of influence between Smart Specialisation Strategies (S3) and regional Circular Economy (CE) policies?

- ☐ S3 is influencing the adoption of regional CE policies
- ☐ Regional CE policies are influencing the formulation of S3
- ☐ There is a reciprocal (mutual) influence between the two
- ☐ There is no link between the two

What do you think is the nature of influence between Smart Specialisation Strategies (S3) and regional Circular Economy (CE) policies?

- ☐ S3 can positively influence the adoption of regional CE policies
- ☐ S3 can negatively influence the adoption of regional CE policies

What do you think is the nature of influence between regional Circular Economy (CE) policies and Smart Specialisation Strategies (S3)?

- ☐ Regional CE policies can positively influence the formulation of S3
- ☐ Regional CE policies can negatively influence the formulation of S3

Section C: Measuring progress towards Circular Economy (CE)

Which of the following is true for your region? (multiple answers possible)

- ☐ We don't measure the progress towards the Circular Economy
- ☐ We are still planning/developing specific regional Circular Economy indicators
- ☐ We are using indicators from the EU Circular Economy monitoring framework
- ☐ We are using indicators from the national Circular Economy monitoring framework
- ☐ We are using other related regional indicators as a proxy
- ☐ We have developed specific regional Circular Economy indicators

Section D: Institutional pressures influencing regional Circular Economy (CE) policies

Please select one answer for each of the questions below.

	Not at all	Slightly	To some extent	To a very high extent	Fully
1. To what extent was/is the adoption of CE policies in your region driven by pertinent international/EU legislation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. To what extent was/is the adoption of CE policies in your region driven by pertinent national legislation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. To what extent was/is the adoption of CE policies in your region driven by pertinent regional legislation?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. To what extent was/is the adoption of CE policies in your region driven by the interaction with other regional stakeholders (from industry, government, academia, society)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. To what extent was/is the adoption of CE policies in your region driven by international/European/national/regional associations, networks, organisations, advisory bodies?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. To what extent was/is the adoption of CE policies in your region driven by awards, certifications, and available EU funding programmes the area of circular economy?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. To what extent was/is the adoption of CE policies in your region inspired by other similar regions (in terms of population/ GDP/ development stage etc.)?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. To what extent was/is the adoption of CE policies in your region inspired by neighbouring regions?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. To what extent was/is the adoption of CE policies in your region inspired by other leading regions in the CE area?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Is there something else that should be explored within this research topic? Do you have any additional comments?

Will you be interested to participate in a short follow-up individual interview?

☐ Yes

☐ No

Appendix E: Interview Protocol

Interview protocol for policy Delphi study

DESIGN AND IMPLEMENTATION OF CIRCULAR ECONOMY POLICIES (CE) AT THE REGIONAL LEVEL: AN EUROPEAN PERSPECTIVE

A PhD research by Arsova Sanja

South-East European Research Centre, Thessaloniki, Greece

Management School, The University of Sheffield, Sheffield, UK

Research Context:

Regions are the most important administrative units of the EU's development policies and so far, have been extensively used for framing and implementing strategic priorities. However, when it comes to regional implementation of the circular economy (CE), there is lack of systematicity both in academic literature and policy documents. The attainment of the European CE policies is strongly associated with initiatives at the local and regional levels. The EU measures will need to take into account the protagonist role of the EU regions in vast numbers of vital aspects of the CE transition, as well as the importance of coordination for ensuring effective multilevel governance. Within this context, this research is focusing on the implementation of CE policies at the regional level. More specifically, to investigate whether Smart Specialisation Strategies (S3) influence the adoption of CE policies at the regional level and explore the influence of institutional pressures on the implementation of regional CE policies. Ultimately, despite the theoretical contribution, the findings of this research will have practical implications as well; findings which could be of interest for policymakers at different levels, in terms of decision making and devising regional policies, as well as for practitioners for encouraging bottom-up actions for future implementation of the CE at the territorial level.

Research Questions:

- **RQ1:** How does Smart Specialisation Strategies (S3), as (normative) institutional pressures, influence the adoption of circular economy policies at the regional level? In that context, does S3 impel the adoption of circular economy policies at the regional level, or in contrary it constitutes a form of lock-in which could even impede a region to adopt circular economy policies?
- **RQ2:** What is the corresponding impact on regional performance across a number of economic, social, and environmental metrics, of selected EU regions?
- **RQ3:** What other institutional pressures, normative, coercive, and mimetic, are influencing the adoption of circular economy policies at the regional level?

Interview questions:

Note: The information gained during this interview will be treated confidentially and will only be used by myself for the purposes of academic research.

A: Regional CE policies

- In the context of transitioning towards the CE, what do you think regarding the regional level of implementation (NUTS 2 level)? How important do you consider the role of regional authorities (policymakers, councils) in this transition? Do you think there should be some aligned course of actions/directions coming from the EU or national governments in terms of the regional formulation of CE policies? Do you consider the existence of an overarching regional CE policy/strategy as vital for the regions in terms of their transitioning path towards a more circular future?
- In the survey you stated that your region has a CE policy. When was it developed? What are the main goals/aims of it? Is it a standalone document, or part of a wider sustainability policy? On whose initiative was it devised (the regional authority, national government)? Was it devised within some EU project (Interreg)? What instruments are being used to accomplish the aims? Who is funding the actions? Who was involved in the formulation process (actors from the industry, society, academia)?
- OR in the survey you stated that your region doesn't have a CE policy. Are you aware if there are some plans to start developing one soon? Is it something that is on the agenda of your institution? Does your region have any wider sustainability policies/strategies?

- OR in the survey you stated that you don't know if your region has CE strategy? Does your region have any wider sustainability policies/strategies?
- In terms of the stages of CE adoption, in the survey you stated your region is in the ...stage. Do you see your region achieving all objectives which were set in the nearby future? What is your opinion on this?
- Is there anything that you would like to add?

B: Smart Specialisation Strategies (S3) and regional CE

- Out of 42 experts, 35 stated their region has S3 strategy, and 25 of them (60%) had for both programming periods (2014-2020 and 2021-2027). Out of these 35, 22 have selected CE as S3 priority in their region. What is interesting is that 11 of the 22 selected CE as S3 priority for the 2021-2027 programming period, and 10 have selected CE as S3 priority for both periods, implying an increased acknowledgement of the CE as a priority in the future regional actions and investment flows. This was also visible from the years when CE was selected as S3 priority, which were 2014 and 2021 (the start years of both programming periods). What is your view on this? Anything to add?
- From the survey we run, there seems to be a mutual link between S3 and the implementation of CE policies (69% of the respondents). Do you agree with this link? Do you see any complexity? Any risk or problematic aspects you see between the relationships? Could things go wrong? What could mitigate these relationships? What could enhance the relationships?
- In terms of the nature of the influence, in both instances all respondents stated a positive relationship between the two concepts: S3 positively influencing the adoption of regional CE policies, and regional CE policies positively influencing the formulation of S3. Do you agree with this link? Do you see any complexity? Any risk or problematic aspects you see between the relationships? Could things go wrong? Is there a risk of lock-in, for example, if a region is implementing a S3 strategy, focusing their investment on industries representing their competitive advantage, is it possible in that way the region to become stuck, because maybe the transition towards the CE will need the mobilisation of other industries which are not part of the region's competitive advantage, so new investments might be needed?
- What is the experience of your region in terms of this? Can you share specific examples? Are you familiar with the S4? What's your view on it?
- Is there anything that you would like to add?

C: Measurement systems/Monitoring frameworks

- How important do you consider the measurement of the CE implementation?

- The results of the survey showed that 29% of the regions are still in the process of developing specific regional CE indicators, (12%) stated they don't measure the progress at all. Almost half of the regions (46%) are using indicators from other levels (EU/national) and other related regional indicators as proxies. Only 13% of the regions have developed specific regional CE indicators. What's your opinion on this? Do you think regional authorities are moving in the right direction or you find these results somewhat worrying?
- In the survey you stated that your region (...) Could you elaborate more on this? Does this initiative come from the regional authority itself, or its sort of imposed from the EU or national authorities, or even national regional associations?
- In the survey you stated that your region doesn't have regional monitoring framework. Why so? Is it because of lack of data?
- What type of indicators you have in the monitoring framework? On what they are focusing (recycling, procurement, consumption etc?) Are they focused on the input side (meaning trying to capture the actions of the region in terms of investments etc) or they are focused on the outcome/output (kg of waste recycled for example)? Do you have indicators which cover the three dimensions of sustainable development (economic, environmental, social)? How frequent are you calculating the indicators (quarterly, bi-annually, annually)?
- In terms of the data availability, do you encounter any challenges (lack of historical data, lack of regional data/incomplete, reporting issues, absence of common methodology etc)? Where do you obtain the data, you need for calculating the indicators?
- Where do you report the progress of the measurement? Is it available somewhere online for the public? Do you have to report it to your national institutions or the EU? How frequent?
- Does your region have any monitoring framework? Or regular adjustment/revision mechanism in place (i.e., monitor the progress of the adopted practices/policies and every 6 months adjust accordingly the policy/strategy and the corresponding actions)?
- What is your opinion about developing an EU regional measurement system for the CE implementation? Do you think it will be beneficial to devise a framework (by CoR for example) which will be adopted by all EU NUTS 2 regions?
- Is there anything that you would like to add?

D: Institutional pressures influencing regional CE policies

- What are the pressures which are more relevant according to you (point on the statements of the survey)? What pressures were more influential for your region to start adopting CE policies (point on the statements of the survey)?
- Coercive: The results of the survey point the EU and national legislation influenced more the regional CE actions rather than the pertinent regional strategies. What's your view on this? How do you reason and explain it? Was this the case with your region?
- Normative: A high % of respondents claimed their regional actions were influenced by the interaction with other regional stakeholders? What's your view on this? Can you share your experience? Any particular stakeholder you would like to highlight? A high % of respondents claimed their regional actions were driven by national/EU/regional associations, networks, organisations, and advisory bodies. What's your view on this? Can you share your experience? Any organisation/body which was important for your region in the journey towards the CE transition? Half of the respondents stated the adoption of CE in their region was not at all (12%) or slightly (38%) driven by awards, certifications, and available EU funding programmes in the area of CE. What's your view on this? Can you share your experience? Did your region participate in any international/EU project (i.e., Interreg Europe)?
- Mimetic: The results show that proximity, i.e., neighbouring regions having already CE policies didn't significantly influence the regions to adopt their own regional policies. Regions were mostly inspired by other similar regions (in terms of GDP, population, development stage) or leading regions in the CE area. What's your view on this? Can you share your experience?
- There seems to be a positive link between coercive and normative pressures. Regions that stated their actions were influenced to a very high extent by pertinent international and EU legislation also stated their actions were influenced to a very high extent by awards, certifications, and available EU funding programmes in the area of CE (9 respondents). Similarly, regions that stated their actions were influenced to a very high extent by pertinent international and EU legislation also stated their actions were influenced to a very high extent by the interaction with other regional stakeholders (8 respondents). Lastly, there seemed to be a connection between statements 4 and 6 within the normative pressures, since 7 respondents stated their regional actions were influenced to a very high extent both by the interaction with other regional stakeholders and by awards, certifications, and available EU funding programmes in the area of CE. What's your view on this? Can you share your experience?
- Is there anything that you would like to add?

E: Mechanisms (multi-level governance and division of powers)

- All efforts coming from the government sector must be coordinated, and the silo-mentality must be avoided. For that purpose, a functional and effective multi-level governance mechanism should be put in place, enabling effective channels of communication, implementation, and reporting – both vertically (e.g., from local governments, through regional, national, and international governments, and vice versa) and horizontally (e.g., regional governments within a country). What's your view on this? Could you share your experience?
- What mechanisms does your country and region have for translating the national strategies into regional ones? Would you say your country has strong enforcement mechanism cascading downwards from the national strategies to the practical regional application of the foreseen measures in your country's regions?
- Do you think there is a need for a more harmonised regulatory framework on CE-related matters which will ensure a more homogenous approach across all regions within a country (within your country)? Do you think that's plausible? Do you think that's something that each EU member state should work on, or the EU, via some of its pertinent bodies (i.e., CoR) should provide the regulatory basis for this harmonised regulatory framework, and the EU member states should leverage on it afterwards?
- Here the division of power within the country must be taken into consideration, since some regions have legislative powers that provide more diverse and powerful instruments and mechanisms for implementing the transition towards the CE than others. For example, Spanish and Belgian regions having more complex institutional arrangements, while in the case of Luxembourg, which is a unitary state with a smaller population, the country simultaneously represents all three NUTS levels, thus reducing the complexity of multi-level governance. Do you have something to say about this?
- Is there anything that you would like to add?

F: Would you like to add anything that has not been covered in this interview?

Thank you very much for your time and effort!

Appendix F: Interview Consent Form

Implementing Circular Economy at a regional level

Invitation paragraph

Dear Participant,

This interview is part of a PhD project which aims to investigate whether Smart Specialisation Strategies (S3) influence the adoption of Circular Economy (CE) policies at the regional level. We are inviting regional policy experts from different organisations and public administration that made some attempts towards CE implementation.

The participation in this research is completely voluntary and you have the right to withdraw at any point without explanation. If you do decide to take part, you will be asked to read and agree to the consent form. Considering the importance and the attention of the CE concept, this research will be beneficial to all regional level stakeholders and organisations who aim to make efforts in implementing relevant policies for CE transition. Hence, your participation will be highly valuable and appreciated.

Data confidentiality

All the information that we collect about you during the course of the research will be kept strictly confidential and anonymised. These anonymised data will not allow any individuals or their organisations to be identified or identifiable. Any data collected about you will be stored online in an encrypted form on a password protected University of Sheffield database.

Funding and ethical grounds of the project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie-Sklódowska-Curie innovative Training Networks (H2020-MSCA-ITN-2018) scheme, grant agreement number 814247 (ReTraCE). The University of Sheffield, Management School will act as the Data Controller for this study. This means that the University of Sheffield, Management School is responsible for looking after your information and using it properly. This project has been ethically reviewed and approved through the University of Sheffield's Ethics Review Procedure, as administered by the guidance provided by the Management School.

Complaints procedure

In case something goes wrong, and you would like to raise a complaint that is related on the way the data collection is handled, or the treatment by the lead researcher you should contact the researcher's supervisory team – Andrea Genovese (a.genovese@sheffield.ac.uk) and Prof. Panayiotis H. Ketikidis (ketikidis@york.citycollege.eu). However, if you feel that the complaint has not been handled properly by the supervisory team you, or in case of something serious occurs in terms of the management of the data by the researcher then you should contact Prof. Rachel Finn (r.l.finn@sheffield.ac.uk) or Sophie May (s.may@sheffield.ac.uk) from the University of Sheffield, and Dr. Kelly Pasmatzis (kpasmatzis@york.citycollege.eu) from the South-East European Research Centre (SEERC).

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Participant Consent Form

Name of Participant:

Please select the appropriate answers:

	Yes (1)	No (2)
I confirm that I have read and understood the terms and condition for participation in the study. (1)	<input type="radio"/>	<input type="radio"/>
I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason and with no foreseeable consequences. (2)	<input type="radio"/>	<input type="radio"/>
I agree to take part in this interview. (3)	<input type="radio"/>	<input type="radio"/>
I agree the interview to be audio and video recorded for the purpose of transcribing it. (6)	<input type="radio"/>	<input type="radio"/>
I understand and agree that my words may be quoted in publications, reports, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this. (4)	<input type="radio"/>	<input type="radio"/>
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield. (5)	<input type="radio"/>	<input type="radio"/>

Appendix G: Interview Transcripts

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Appendix H: Template Analysis – Final Template

Template V5:

1. The regional narrative in the CE transition [CODE]

Short theme description: This theme focused on presenting the regional narrative for the CE transition, divided in two major sub-themes. The first one was related to all the aspects and determinants which are defining each region and consequently the regional trajectory it will have towards the CE. The second one encompassed the role and importance of regions in the CE transition, looking at the term region from two perspectives: as a level of implementation and as regional authority.

1.1 Regional identity forming aspects

1.1.1 Chronological arrangements

1.1.1.1 Former

1.1.1.2 Incumbent

1.1.1.3 Prospective

1.1.2 Regional influential factors

1.1.2.1 Regional barriers/challenges

1.1.2.2 Regional strengths/competitive advantages

1.1.2.3 Regional opportunities

1.1.3 Regional dynamics

1.1.3.1 Geographic factors

1.1.3.2 Economic factors

1.1.3.3 Social factors

1.1.3.4 Environmental factors

1.1.3.5 Political factors

1.1.3.6 Cultural factors

1.1.3.7 Technological factors

1.1.3.8 Industrial structure of the region

1.1.3.8.1 Natural resource-based industries (NRBIs)

1.2 Role and importance of regions in the CE transition

1.2.1 Varying importance of regions depending on:

1.2.1.1 Degree of political authority (division of power)

1.2.1.2 Amount of financial resources regions can mobilise

1.2.1.2.1 Developed vs. lagging behind regions

1.2.1.3 Regional capacities to govern instruments and influence actions

1.2.2 As level of implementation

- 1.2.2.1 Optimal scale fit for structural purposes
 - 1.2.2.1.1 National level too big
 - 1.2.2.1.2 Municipal level too small
- 1.2.2.2 Collection of natural resources (at local level) vs. exploitation of natural resources (at regional level)
- 1.2.2.3 Province (NUTS 2) as authority in the middle
 - 1.2.2.3.1 Highly fragmented territorial division
- 1.2.2.4 Bottlenecks at regional level for implementing diverse set of policies
 - 1.2.2.4.1 Change the scale of consideration
- 1.2.3 As regional authority (roles)
 - 1.2.3.1 Implementing CE activities
 - 1.2.3.2 Providing legislative framework
 - 1.2.3.3 Providing economic incentives & disincentives
 - 1.2.3.4 Mobilising regional ecosystem
 - 1.2.3.4.1 Involve stakeholders in co-creation process
 - 1.2.3.4.2 Increase awareness & education to stakeholders outside of public sector
 - 1.2.3.4.3 Enable collaborative learning among stakeholders
 - 1.2.3.5 Allocating & managing EU funds
 - 1.2.3.6 Monitoring and measuring of regional CE progress
 - 1.2.3.7 Coordinating lower territorial units
 - 1.2.3.8 Conveying EU policies and initiatives to local territories
 - 1.2.3.9 Catalysers between national and municipal level
 - 1.2.3.9.1 National level still very important
 - 1.2.3.9.2 Maximisation of interplay between all governance levels
 - 1.2.3.10 Addressing environmental challenges in NRBI
 - 1.2.3.11 Include the public sector in the global CE transition dominated by industrial actors

2. Division of power as common denominator for EU regions **[CODE]**

Short theme description: This theme has focused on the division of power within the EU regions and its impact on the CE policy formulation and adoption. The fragmented legislative landscape with the main caveats was covered in the first sub-theme, while the organisational transformation of the regional administration in the context of the CE transition was presented afterwards.

2.1 Fragmented legislative landscape

2.1.1 Regionalisation

2.1.1.1 MS with legislative powers at the sub-national level

- 2.1.1.1.1 The issue of devolution
 - 2.1.1.2 Regional autonomy
 - 2.1.1.2.1 Devising regional laws
 - 2.1.1.2.2 Mobilising regional stakeholders
 - 2.1.1.3 Caveats
 - 2.1.1.3.1 Gridlock between levels of governments
 - 2.1.2 Unitarisation
 - 2.1.2.1 MS without legislative powers at the sub-national level
 - 2.1.2.2 Leverage on Regional Funds as strongest policy instrument
 - 2.1.2.3 Caveats
 - 2.1.2.3.1 Regions having limited planning capabilities
 - 2.1.2.3.2 Lack of regional autonomy
 - 2.1.2.3.3 Difficult to advance a centrally devised strategy
 - 2.1.2.3.4 Delegation of tasks without budgeted allocation for implementation
 - 2.1.3 Balanced (formal & informal) power distribution
 - 2.1.3.1.1 Harmonious symbiosis between central government and local level
 - 2.1.3.1.2 Good multi-level governance
 - 2.1.3.1.3 Local level involved in policy design & planning
 - 2.1.3.1.4 Positive action with the government, not a race against it
 - 2.1.3.1.5 Strong institutional capabilities
 - 2.1.3.1.6 Organisation culture & value of regional authority aligned with environmental affairs
 - 2.1.3.1.7 Informal governance
 - 2.1.3.1.8 Cooperation for lobbying CE agenda on the policy bills
 - 2.1.4 Proposals from Brussels “blind” on the division of power among EU regions
 - 2.1.5 CCRI initiative providing recommendations for policy formulation
- 2.2 Organisational transformation of regional administration
- 2.2.1 Shift of focus
 - 2.2.1.1 Sectors vs. challenges
 - 2.2.1.1.1 Traditionally organised around sectors
 - 2.2.1.1.2 Now organised around challenges
 - 2.2.1.2 Sectors vs. transition
 - 2.2.1.2.1 Traditionally organised around sectoral approach
 - 2.2.1.2.2 Now organised around transition themes
 - 2.2.1.3 Regional strengths vs. intent for transformation
 - 2.2.1.3.1 Traditionally focused on regionally strong industries
 - 2.2.1.3.2 Now focused on all SME’s wanting to transition towards CE
 - 2.2.2 Shift of ministry’s competences
 - 2.2.2.1 Traditionally ministry of environment pushing CE agenda

- 2.2.2.2 Now all ministries have competences in CE matters
- 2.2.3 Shift of short-term effort
 - 2.2.3.1 From changing the organisational structure
 - 2.2.3.2 To having a clear CE vision and pursuing it
- 2.2.4 Change of mindsets & perspectives
 - 2.2.4.1 Focus on what you can do, not on what you cannot do
- 2.2.5 Overcome silo mentality/modus operandi of projects
 - 2.2.5.1 Focus on the challenge, not on the competences

2.3 Changing the dynamics through transformative action, to change institutions

- 2.3.1 Rigid institutions & inflexible organisational structures
- 2.3.2 Level of issuing regulation is irrelevant for stakeholders
- 2.3.3 Responsibility of local authorities to mobilise stakeholders and make good use of funds with existing capacities
- 2.3.4 Living constellation of stakeholders' evolution to affect the whole regional ecosystem
- 2.3.5 Leverage on informal governance to address pressing environmental challenges

3. Multi-level governance mechanisms [CODE]

Short theme description: This theme focused on the need of having a unified narrative towards the CE transition through the existence of functional and efficient multi-level governance mechanism; including vertical and horizontal governance imperative, as well as the existing institutional structures and capacities within the region itself.

- 3.1 Unifying narrative based on functional and efficient multi-level governance mechanisms
 - 3.1.1 Vertical governance imperative
 - 3.1.1.1 Balanced power distribution
 - 3.1.1.1.1 Formal power
 - 3.1.1.1.1.1 Attention from the direction
 - 3.1.1.1.2 Informal power
 - 3.1.1.1.2.1 Agents under the radar
 - 3.1.1.1.2.2 Informal governance
 - 3.1.1.2 Focus on directionality rather than coordination
 - 3.1.1.2.1 Less coordination, more transformative action
 - 3.1.1.3 Lack of coordination
 - 3.1.1.3.1 Decelerate processes
 - 3.1.1.3.2 Increased complexities

- 3.1.1.3.3 CCRI initiative to provide support to lagging behind regions
 - 3.1.1.4 Vertical cooperation
 - 3.1.1.4.1 Transfer strategies from EU level to local level
 - 3.1.1.4.2 Lack of cooperation between national and regional level
 - 3.1.1.4.2.1 Not a matter of consistency or harmonisation
 - 3.1.1.4.3 Reinforce cooperation with municipalities
 - 3.1.1.4.3.1 Target an agenda of high importance at their level
 - 3.1.1.5 Lack of directionality
 - 3.1.2 Horizontal governance imperative
 - 3.1.2.1 Coordination of multiple regional strategies
 - 3.1.2.2 Regional level efficiency depending on regional governance development
 - 3.1.2.3 Knowledge sharing
 - 3.1.3 Maximisation of interplay between all governance levels
 - 3.1.3.1 Need for EU to push for collaborative learning
 - 3.1.3.2 EU bringing all relevant stakeholder together for knowledge exchange
- 3.2 Institutional structure and environment of the region
 - 3.2.1 Collaboration and trust building happening locally
 - 3.2.2 Reinforce collaboration
 - 3.2.2.1 Role of researchers
 - 3.2.2.2 Set up joint objectives
 - 3.2.3 Ensure perpetuity between political cycles
 - 3.2.4 Capacity & leadership at the regional level to envisage long-term vision & actions
 - 3.2.4.1 Feeling agency over their own future
 - 3.2.4.1.1 Vouch for early inclusion of the public sector in the CE transition
 - 3.2.4.1.2 Ability to cooperate for lobbying on CE agenda for policy bills
 - 3.2.4.2 Lacking capacities of regional authorities to plan, design & execute strategies
 - 3.2.4.2.1 Uneven availability of skilled public servants in regional authorities
 - 3.2.4.3 Existence of capacities/functional institutional structures at some level of the country
 - 3.2.4.3.1 Serious issue when there is general lack
 - 3.2.4.4 Required investment in human capital at regional authorities
 - 3.2.4.4.1 Available unused instruments to invest in regional capacities/institutions
 - 3.2.4.4.2 Issue of devolution
 - 3.2.4.4.3 Readiness to invest in their own capacities
 - 3.2.5 Transversal coordination unit going beyond departmental borders
 - 3.2.5.1 Regions adopting holistic & system approach in public institutions
 - 3.2.5.2 It's not about new institutional bodies, it's about connecting the dots

4. Formulation & implementation of developmental strategies [CODE]

Short theme description: This theme focused on the approaches for formulation and implementation of developmental strategies, including the regional CE strategies within the EU context. Additionally, the complex and lengthy legislative decision-making process in the EU is briefly included.

4.1 General approaches for formulating developmental strategies

4.1.1 Top-down approach

4.1.1.1 Regulation

4.1.1.2 Economic instruments (incentives or penalties)

4.1.1.3 Education for capacity building

4.1.1.4 Caveats

4.1.1.4.1 Not receive full attention from stakeholders

4.1.1.4.2 Not receive full acceptance by stakeholders

4.1.2 Bottom-up approach

4.1.2.1 Based on local demands and natural interest of local stakeholders

4.1.2.2 Similar to local resource scenario

4.1.2.3 Based on local activities, customs, culture, resources, and capacity

4.1.2.4 Caveats

4.1.2.4.1 Long learning curve

4.1.2.4.2 Achieve target in a long process with difficulties

4.1.3 Side-way in approach

4.1.3.1 Combine benchmarking and leapfrogging

4.1.3.2 Rely on mimetic pressures

4.1.3.2.1 Look for success stories from other industries, economies

4.1.3.2.2 Avoid repeating past mistakes and void investments

4.1.3.3 Bring in expert/consultant for guidance

4.1.3.4 Attain target more effectively & efficiently

4.1.4 Roundput

4.1.5 Back casting – EU strategy development

4.2 Developmental strategies determinants

4.2.1 Increasingly polarised world

4.2.2 Interlocked Europe

4.3 EU's legislative decision-making process

4.3.1 Complex environment & lengthy process

4.3.2 CoR & ESC non-legally binding opinions

5. Architecture of regional CE policies [CODE]

Short theme description: This theme focused on exploring the arrangement of the regional CE policies. More particularly, on the different policy configurations in which CE appears as an element or a standalone policy, and the distinctive scenarios which led in one way or another the initiation of a CE policy. Furthermore, the varying stages of CE policy implementation among the EU regions were presented, along with some of the main issues encountered.

5.1 Regional CE policies

5.1.1 Importance of CE policies

5.1.1.1 Providing overall vision

5.1.1.2 Provide directionality

5.1.1.3 Leverages on funding indispensable for transition

5.1.2 Important determinants to be considered

5.1.2.1 Place-based approach entangled

5.1.2.2 Systemic changes required

5.1.2.2.1 Need for system boundaries delineation

5.1.2.2.1.1 EU general guidelines

5.1.2.3 High-level (EU) goal orientation

5.1.2.4 No “one-size-fits-all” solution

5.1.2.5 Focus on feasibility of policy

5.1.2.6 Local ownership of the CE agenda

5.1.2.7 Provide overall framework where regional authorities can innovate

5.1.3 Nuanced interlinkages between regional CE policy & CE advancement

5.2 Policy configuration

5.2.1 Lack of regional CE policy

5.2.1.1 No intentions for devising regional CE policy

5.2.2 Standalone regional CE policy

5.2.2.1 Sector (industry) specific CE policy

5.2.2.2 CE Action Plan resulting from ad-hoc projects

5.2.2.3 Alignment with EU policies

5.2.2.4 Alignment with regional S3

5.2.3 Wider sustainability agenda

5.2.4 Twin transition (digital and green)

5.2.5 Part of S3

5.2.5.1 As S3 priority

5.2.5.2 As central element

5.2.5.3 As sectoral driver

5.2.6 Part of National S3

- 5.2.6.1 Lack of idiosyncrasies
- 5.2.7 Existence of CE policies on other levels
 - 5.2.7.1 National level
 - 5.2.7.2 City level

5.3 CE policy initiation and development

- 5.3.1 Provincial elections with CE political agenda
- 5.3.2 Policy development on regional initiative
 - 5.3.2.1 Coordinated & contracted by regional government
 - 5.3.2.1.1 Formulated by several universities
 - 5.3.2.1.2 Consultation with Triple Helix actors
 - 5.3.2.1.3 Lack of involvement of societal actors
 - 5.3.2.2 Genuine interest in CE agenda of regional authorities
 - 5.3.2.2.1 Establish a platform enabling to work on CE related issues
 - 5.3.2.2.2 Founded on normative & innovative approaches to mobilise regional ecosystem
 - 5.3.2.2.3 Co-creation approach followed
 - 5.3.2.2.4 Initiate program for SME's interested in CE transitioning
 - 5.3.2.2.5 Municipal funding for CE-related projects
 - 5.3.2.2.6 Value chain importance
 - 5.3.2.2.6.1 Identify "piloting" areas for testing & gaining knowledge
- 5.3.3 Shift of organisational structures and modus operandi
- 5.3.4 Top-down conditionality
 - 5.3.4.1 Framed and delegated from the national level
 - 5.3.4.2 Increased compliance and requirements
 - 5.3.4.3 EU introducing CE related policies & initiatives
 - 5.3.4.3.1 Impediments for EU initiatives reaching all regions simultaneously
 - 5.3.4.3.1.1 Need for a particular governance structure
 - 5.3.4.3.1.2 Need for more focused approach targeting specific areas
 - 5.3.4.3.2 Regional actions affecting EU policies
 - 5.3.4.3.3 Disjuncture of transposition process
 - 5.3.4.3.3.1 EU political priorities more influential than national ones
 - 5.3.4.3.3.2 Risk to strangle innovation
- 5.3.5 Conversion of Regional Waste Management Plans into regional CE policies
 - 5.3.5.1 Very sector specific focus
 - 5.3.5.1.1 Focused on waste management
 - 5.3.5.1.2 Focused on plastics/food waste/sharing economy
 - 5.3.5.1.3 Focused on environmental education
- 5.3.6 Scattered CE related activities undertaken within EU projects
- 5.3.7 Difficulties in identifying the exact initiator of the regional CE policy

5.4 CE policy implementation stages and issues

5.4.1 CE perceived as business as usual

5.4.1.1 Policy penetration in wide range of existing regional policies

5.4.1.1.1 Integration of CE concept

5.4.2 Policy development in process

5.4.2.1 Regulatory compliance

5.4.3 CE concept started penetrating in related policies

5.4.3.1 Time lag: West & North Europe vs South & East Europe

5.4.4 Lack of overarching CE policy, but existence of scattered CE activities

5.4.5 Lack of realisation

5.4.5.1 Immaturity of the CE concept

5.4.5.2 Policy prioritisation issue

5.4.5.3 Need for local ownership of the CE agenda

5.4.5.4 Lack of regional enforcement mechanisms

5.4.5.5 Difficulties in CE implementation on industry side

5.4.5.5.1 SME's disengagement with the CE agenda

5.4.5.6 Rigidity of the state apparatus

5.4.6 Lack of CE realisation on EU level

5.4.6.1 Technology available, but market is not adapting

5.4.7 Perplexity of inception point

6. S3 & CE nexus: influences, risks & mitigation mechanisms [CODE]

Short theme description: This theme focused on investigating the nexus between S3 and CE, trying to uncover initially the direction of influence between the two strategies within the EU regional context, and subsequently to identify the nature of influence. A less deterministic relationship appears to exist with several risks of adverse influence, and respective risk mitigation actions need to be considered. Additionally, the overall formulation and implementation aspects of the S3 have been covered.

6.1 General notions related to the survey

6.1.1 Ambiguity in the survey questions

6.1.1.1 Presumption vs. reality

6.1.2 Participants in the survey – most active in S3 overall (usual suspects)

6.1.3 Survey respondent's background to be considered

6.1.4 Survey results demonstrating amount of ownership of S3

6.1.5 Distinction between CE & sustainable development

6.2 Direction of influence between S3 & CE

- 6.2.1 S3 influencing the adoption of regional CE policies
 - 6.2.1.1 S3 as non-compulsory element of CE policies
 - 6.2.1.2 Leveraging on S3 for CE transition
 - 6.2.1.2.1 Allocation of EU funds for green objectives
 - 6.2.1.3 S3 influencing CE due to earlier penetration in policy frameworks
 - 6.2.1.3.1 Maturity & stability of S3
 - 6.2.2 Regional CE policies influencing the formulation of S3
 - 6.2.2.1 S3 containing CE elements
 - 6.2.2.2 S3 integrated with horizontal strategies, including CE
 - 6.2.2.3 S3 as instrument for overall sustainability strategies
 - 6.2.2.4 CE as central element of S3
 - 6.2.2.4.1 Building on complementarities between green, inclusive & smart growth
 - 6.2.2.5 CE as transversal S3 priority
 - 6.2.2.6 CE as regional S3 priority
 - 6.2.2.7 Shift of priorities (from competitiveness/specialisation to SDGs/CE)
 - 6.2.3 Mutual influence
 - 6.2.3.1 Connection between regional S3 priorities & national CE goals
 - 6.2.3.2 Degree of alignment between S3 & CE depending on time factor
 - 6.2.3.3 Constant interplay between the two
 - 6.2.3.3.1 Due to increased awareness
 - 6.2.3.4 Overlap of concepts & evolution of ideas
 - 6.2.3.4.1 Main principles of S3 at the heart of CE
 - 6.2.3.5 CE – flagship initiative of the EU, influencing the S3
 - 6.2.4 Disjuncture between S3 & CE
 - 6.2.4.1 Due to ambiguity in S3 policy scope
 - 6.2.4.2 Due to differences in optimal implementation levels
 - 6.2.4.2.1 S3 designed at regional level
 - 6.2.4.2.2 CE policies designed at more strategic geographical level
- 6.3 Nature of influence between S3 & CE
- 6.3.1 Positive influence between S3 & CE
 - 6.3.1.1 Positive path dependency situation
 - 6.3.1.2 Complementing each other
 - 6.3.1.3 EU regulation binding regions to green transition fund orientation
 - 6.3.2 Risk of adverse influence between S3 & CE: triggers & scenarios
 - 6.3.2.1 Problematic trajectories
 - 6.3.2.1.1 Regional lock-in in liner supply chains
 - 6.3.2.1.2 Negative path dependency situation
 - 6.3.2.1.3 Production cycle lock-in due to geographical & geopolitical factors

- 6.3.2.1.4 Region's strong industrial cluster incompatible with CE transition in fundamental aspects
 - 6.3.2.1.5 Unfit heuristic of S3 for broader sustainability transition
 - 6.3.2.1.6 Economic & environmental inefficiency for regional supply chains
 - 6.3.2.1.7 Inter-regional dependency for some value chains & complex interplay beyond regional level
 - 6.3.2.2 S3 & thematic platforms not focusing on the transition
 - 6.3.2.2.1 Cross-sectoriality: glue for the transition
 - 6.3.2.2.2 Dedicated themes & resources working on cross-sectoriality
 - 6.3.3 Positive & adverse influence between S3 & CE
 - 6.3.3.1 Trade-offs & complementarities
 - 6.3.3.1.1 Success parameter (apply at scale, over long-term commitments in lagging behind regions)
 - 6.3.3.2 (In)efficient link between S3 & CE policies
 - 6.3.3.2.1 Regulatory obligation/administrative procedure to obtain EU funds (interpreting S3 narrowly)
 - 6.3.3.2.2 Capturing S3 as transformative strategy incorporating innovative approaches (comprehending S3 strategic aspects)
 - 6.3.3.3 Constellation of stakeholders
 - 6.3.3.3.1 Avoidance of monopoly situation
 - 6.3.3.3.1.1 Key industrial players at the core of current economy
 - 6.3.3.3.2 Inclination towards ecosystem setup
 - 6.3.3.3.2.1 Incentivising role of territories/regions
 - 6.3.3.3.2.2 Support SMEs wanting to transition towards CE
- 6.4 Reasons for regional lock-in
- 6.4.1 Ambiguity of CE strategy and undefined boundaries
 - 6.4.2 Tensions due to incumbent structures & networks confrontation
 - 6.4.3 Risk of key industrial players in unsustainable core industries lobbying & monopolising the CE agenda
 - 6.4.4 Inability to ensure perpetuity between political cycles
 - 6.4.4.1 Functional governance structures
 - 6.4.4.2 Effective institutional environment
 - 6.4.5 S3 heuristic of prioritising areas of strengths, unsustainable in some fundamental dimension
 - 6.4.5.1 NRBI's (e.g. Coal regions)
 - 6.4.5.2 EU commitment to phase out such activities by 2030
 - 6.4.6 Current prioritisation of industries within a region based on:
 - 6.4.6.1 Proximity to resources (raw materials)
 - 6.4.6.2 Proximity to human resources (availability of skill)

- 6.5 Risk mitigation mechanisms of adverse influence
 - 6.5.1 Include CE elements in existing unsustainable industry
 - 6.5.2 Repurpose industry utterly towards CE
 - 6.5.3 Support interested SMEs willing to transition towards CE
 - 6.5.4 PRI introducing new heuristic emphasising sustainable development
 - 6.5.4.1 Based on regional challenges & opportunities
 - 6.5.5 Introduce transition themes within S3
 - 6.5.6 Need for inter-regional supply chains
 - 6.5.6.1 I3 instruments on inter-regional investment
 - 6.5.7 Include preliminary risk assessment to the regional prioritisation of industries based on their:
 - 6.5.7.1 Energy consumption
 - 6.5.7.2 Water consumption
 - 6.5.7.3 Pollution impact generation
- 6.6 S3 formulation & implementation: general conclusions
 - 6.6.1 Vagueness in S3 definition
 - 6.6.2 Focused on waste management aspects, limited sensitivity to CE
 - 6.6.3 Overly ambitions to be fully implemented
 - 6.6.4 Systemic delays in applicability of operational plans
 - 6.6.5 Omitting inclusion of core regional sectors related to CE
 - 6.6.6 Formulated following bottom-up approach
 - 6.6.6.1 Emerging from the regional ecosystem (Triple helix actors)
 - 6.6.6.1.1 Need for institutions supporting innovation transfer to smaller enterprises
 - 6.6.6.1.2 Meet expectations, design, and plan of national authorities
 - 6.6.6.1.3 National government answerable to EC and EU Court of Auditors for regionally spent EU funds
 - 6.6.6.2 Entrepreneurial Discovery Process (EDP)
 - 6.6.6.3 Open Discovery Process (ODP)
 - 6.6.7 Formulated following a top-down conditionality from national S3
 - 6.6.8 S3 formulation connected to the regional economic added value & specialisation
 - 6.6.9 Regulatory obligation/administrative procedure to obtain EU Funds
 - 6.6.10 S3 implementation instruments
 - 6.6.10.1 Support for technology transfer
 - 6.6.10.2 Company grants for innovation oriented towards sustainability
 - 6.6.10.3 Programmes for labs
 - 6.6.10.4 One-Stop Liasson Office within the S3
 - 6.6.10.4.1 Provide leverage for CE initiatives as well

- 6.6.11 Varying importance of S3 in EU regions
 - 6.6.11.1 Depending on the importance of EU regional funds in the region
 - 6.6.11.2 S3 & CE links in decentralised MS reliant on regional leadership
 - 6.6.11.2.1 S3 used for systemic change vs. process for receiving structural funds
- 6.6.12 S4+ smart specialisation strategies for sustainable and inclusive growth
 - 6.6.12.1 Academic discussion only, not political one yet
 - 6.6.12.2 Regions including S4 in regional strategies as branding exercise

7. EU Green Deal & CE policies: formulation, implementation & main challenges

[CODE]

Short them description: This theme focused on exploring the role and links of the EU Green Deal and the CE, as one of its main building blocks. Namely, the three focal sub-themes investigated were the approaches of formulation and implementation of the CE and EU Green Deal, the main challenges for their implementation as well as their potential role to act as an accelerator of the divide. Furthermore, the crucial role of the PRI initiative in the future was presented.

7.1 EU Green Deal

- 7.1.1 EU's environmental & development strategy
- 7.1.2 Implementation is national competence, limited EU interventions
- 7.1.3 Political momentum for place-based policies
- 7.1.4 Funding Facilities
 - 7.1.4.1 Designed at national level
 - 7.1.4.2 Neglecting regional involvement
 - 7.1.4.3 Structural Funds (Operational programmes)
 - 7.1.4.3.1 Geographical vs. sectoral programmes
 - 7.1.4.3.2 General environmental conditionalities
- 7.1.5 CE as part of green transition
 - 7.1.5.1 CEAP: complex action involving systemic change
 - 7.1.5.2 Implementation as focal point

7.2 CE/EU Green Deal approaches of formulation and implementation

- 7.2.1 Very top-down approach
 - 7.2.1.1 Providing directionality
 - 7.2.1.2 Caveats
 - 7.2.1.2.1 Land on certain type of places (already advanced)
 - 7.2.1.2.2 Generates conflicts & frustrations

- 7.2.1.2.3 Squeeze out innovation (fewer degrees of thinking freedom)
 - 7.2.1.3 Ensure it reaches weaker places too
 - 7.2.2 Need for bottom-up initiatives as well
 - 7.2.3 Balanced approach
 - 7.2.3.1 Increase interaction between top-down & bottom-up
 - 7.2.4 “Chimney” vs. “trickling” effect
 - 7.2.5 Need for consolidation of the Green Deal in the long run
 - 7.2.5.1 Assess in detail the capacity of the EU to reach the target
 - 7.2.5.2 Identify the delta between the capacity & the target
 - 7.2.5.3 Design instruments to meet the delta
 - 7.2.6 General harmonisation of objectives at EU level
 - 7.2.6.1 Degrees of regional freedom for objective attainment
 - 7.2.6.2 CCRI assisting regions on targeted EU funding
- 7.3 CE/EU Green Deal challenges
- 7.3.1 Importance of complementarities
 - 7.3.2 The question of green readiness of EU regions
 - 7.3.3 The risk of Matthew effect
 - 7.3.3.1 Cohesion policy to counterbalance
 - 7.3.3.2 The core of CCRI collaborative learning scheme
 - 7.3.3.2.1 Team up Pilots & Fellows to ensure geographical balance
 - 7.3.4 Economic incentives vs. coercive measures
 - 7.3.5 Lobbyism from large companies
 - 7.3.5.1 Introduce coercive measures through legislation
 - 7.3.6 EU Green Deal going local – reality check
 - 7.3.6.1 Bottleneck at regional level for wider range of policy implementation
 - 7.3.6.1.1 Due to current sectoral approach of implementation
 - 7.3.6.2 Policy design for regulation done without proper ex-ante territorial impact assessment
 - 7.3.6.2.1 Ex-post impact assessment only
 - 7.3.7 Green Deal debate – big city debate, not a regional debate
 - 7.3.7.1 Aspects of place & distance not on the Green Deal radar
 - 7.3.7.2 Regions with production capacities facing bigger challenges compared to consumption driven cities
 - 7.3.8 Typology of regions
 - 7.3.8.1 Benchmarking & assessment criteria for validating the EU divide
 - 7.3.9 EU to assume more responsibilities for cohesive regional transitioning
- 7.4 CE/EU Green Deal as potential accelerator of the divide
- 7.4.1 Success parameters (apply at scale, over long-term commitments in lagging behind regions)

- 7.4.2 (In)effective use of disposable EU funds
- 7.4.3 North vs. South divide
- 7.4.4 Lagging behind regions
 - 7.4.4.1 Natural Resource-Based Industries (NRBIs)
 - 7.4.4.1.1 Unsustainable activities to be phased out by 2030
 - 7.4.4.2 Lack of long-term vision due to operating companies' structure
 - 7.4.4.2.1 Market responders
 - 7.4.4.2.2 Very short investment span
 - 7.4.4.2.3 System geared to day-to-day management
 - 7.4.4.3 Difficult to inject leadership, capacity, and knowledge from the outside
 - 7.4.4.3.1 Promote institutional learning for politicians
- 7.4.5 Advanced regions (frontrunners)
 - 7.4.5.1 Long-term vision due to operating companies' structure
 - 7.4.5.1.1 Strong debris of big companies
 - 7.4.5.1.2 Market shapers
- 7.4.6 Doubts of CE/EU Green Deal acting as accelerator of divide
 - 7.4.6.1 Unique window of opportunity to close the divide
 - 7.4.6.1.1 Recovery funds
 - 7.4.6.2 Attempts of CCRI to ensure all MS transition in the same direction

7.5 EU/JRC initiative - Partnership for Regional Innovation (PRI)

- 7.5.1 Essence of PRI approach
 - 7.5.1.1 Synthesise the spirit of S3 with sustainability process
 - 7.5.1.2 Consider growth compatible with sustainability goals
 - 7.5.1.3 Development of regional transitional strategies engaging all policies
 - 7.5.1.4 Provide a framework more receptive to transformation
 - 7.5.1.4.1 Introduce new heuristic emphasising sustainable development
 - 7.5.1.4.2 Grasping regional challenges & opportunities through innovation
- 7.5.2 Co-creation phase
 - 7.5.2.1 No legislative framework yet
 - 7.5.2.2 Acting as inspiration for change in current programming period
 - 7.5.2.3 Genuine recognition for more sustainable development paths

8. Institutional pressures driving the adoption of regional CE policies [CODE]

Short theme description: This theme is focusing on the institutional pressures that are influencing the adoption of CE policies within the EU regions. In that context, three types of main pressures (isomorphisms) are listed, coercive, normative, and mimetic pressures, along with their sub-categories emerging from the inductive and deductive coding. Additionally,

the need to increase the influence of the normative and mimetic pressures on the adoption of regional CE policies is acknowledged.

8.1 Coercive pressures (isomorphism)

8.1.1 International legislation

8.1.2 EU legislation

8.1.2.1 EU Green Deal

8.1.2.2 CE Action Plan

8.1.2.3 Most influential (top-down) driver on national level

8.1.2.4 Regulatory compliance

8.1.2.5 Transposition of EU laws into national legislation

8.1.3 National legislation

8.1.3.1 National S3

8.1.3.2 Hesitance for initiating national laws, reliance on EU laws

8.1.4 Pertinent regional legislation

8.1.4.1 Regional S3

8.1.4.2 Wider sustainability strategy

8.1.4.3 Sector specific strategy

8.1.4.4 Lowest influence on regional CE implementation

8.1.4.4.1 Ring a bell to the transposition process

8.1.5 Common denominators for coercive pressures

8.1.5.1 Frame as legislative instead of coercive pressures

8.1.5.2 Top-down approach

8.1.5.2.1 Regulatory compliance

8.1.5.2.1.1 Potential adverse effects

8.1.5.2.2 Trickle-down effect

8.1.5.2.2.1 Hinge on EU legislation to boost regional agenda acceptance

8.1.5.2.2.2 EU taking the lead, but CE must happen at the local level

8.2 Normative pressures (isomorphism)

8.2.1 Interaction with regional stakeholders

8.2.1.1 Government/public administrations/provincial elections

8.2.1.2 Industry/companies/business agencies

8.2.1.3 Academia/scientific institutes/researchers

8.2.1.4 Society/households/citizens/associations/NGOs

8.2.1.4.1 Lack of involvement in regional CE policy formulation

8.2.1.5 EU Institutions

8.2.1.5.1 Importance of non-regional stakeholders

8.2.1.6 Bottom-up approach

8.2.1.6.1 Expect CE transition to be boosted by SME's

8.2.1.6.2 Importance of stakeholder analysis

- 8.2.1.6.3 Establishment of local support group
 - 8.2.1.6.4 Quadruple helix model
- 8.2.2 International/EU/national/regional associations/networks/organisations/advisory bodies
 - 8.2.2.1 At International level
 - 8.2.2.1.1 Ellen MacArthur Foundation
 - 8.2.2.1.2 Conference of the Parties of the UNFCCC (COP 27)
 - 8.2.2.2 At EU level
 - 8.2.2.2.1 Partnership for Regional Innovation (PRI)
 - 8.2.2.2.2 The European Committee of the Regions (CoR)
 - 8.2.2.2.3 European Economic and Social Committee (EESC)
 - 8.2.2.2.4 European Circular Economy Stakeholders Platform (ECESP)
 - 8.2.2.2.5 Circular Cities and Regions Initiative (CCRI)
 - 8.2.2.2.6 European Regions Research and Innovation Network (ERRIN)
 - 8.2.2.2.7 Covenant of Mayors
 - 8.2.2.2.8 Bio based Industries Consortium Joint Undertaking (BBI JU)
 - 8.2.2.2.9 Initiative for coal regions in transition
 - 8.2.2.2.10 Network of European Regions for Innovation in Agriculture, Food and Forestry (ERIAFF)
 - 8.2.2.2.11 Nordic regions
 - 8.2.2.3 At National level
 - 8.2.2.3.1 House of Dutch provinces in Brussels
 - 8.2.2.3.2 Danish Federation of Regions
 - 8.2.2.3.3 Danish Federation of Industries
 - 8.2.2.3.4 Specialised interprovincial institute (the Netherlands)
 - 8.2.2.4 At regional level
 - 8.2.2.4.1 Circular Holland Hotspot
 - 8.2.2.4.2 Circular Friesland
 - 8.2.2.4.3 Cluster of Bioeconomy and Environment of Western Macedonia (CLuBE)
 - 8.2.2.5 Lack of pressure from economic associations
 - 8.2.2.5.1 Fear of more barriers (legislation, expenses)
- 8.2.3 Awards, certifications, and available EU funding programmes the area of circular economy
 - 8.2.3.1 Specific pressure being more influential in poorer MS and regions
 - 8.2.3.2 Awards
 - 8.2.3.2.1 Risk of greenwashing
 - 8.2.3.2.2 Increase transparency of financial reporting
 - 8.2.3.3 EU fundings programmes
 - 8.2.3.3.1 NEXT Generation EU Plan
 - 8.2.3.3.2 Resilience Recovery Facility

- 8.2.3.3.3 Operational programmes
- 8.2.3.3.4 Interreg projects
- 8.2.3.3.5 LIFE IP projects
- 8.2.3.3.6 Knowledge transfer besides funding opportunities

8.3 Mimetic pressures (isomorphism)

- 8.3.1 Best practices from:
 - 8.3.1.1 EU countries
 - 8.3.1.1.1 Within EU projects & networks
 - 8.3.1.1.1.1 Enable inter-regional cooperation
 - 8.3.1.1.1.2 Mutual learning taking place
 - 8.3.1.2 Neighbouring countries
 - 8.3.1.3 Municipalities (within country)
 - 8.3.1.4 Leading regions in the area of CE
 - 8.3.1.5 Neighbouring regions
 - 8.3.1.5.1 In practice more influential & important
 - 8.3.1.6 Breakthrough projects in other provinces (within country)
- 8.3.2 Regional policies within the country
- 8.3.3 Frontrunners not inspired by other regions
 - 8.3.3.1 Inspired by Ellen MacArthur foundation (within CE100)
 - 8.3.3.1.1 Inspired by frontrunning cities (within CE100)
 - 8.3.3.1.2 Inspired by oriented people with drive for CE actions

8.4 Relative importance/influence of pressures

- 8.4.1 Increase influence of:
 - 8.4.1.1 National legislation (coercive pressures)
 - 8.4.1.2 Pertinent regional legislation (coercive pressures)
 - 8.4.1.3 Normative pressures
 - 8.4.1.4 Mimetic pressures
- 8.4.2 Triggers to increase influence

9. The vital role of CE hubs (networks) in the transition [CODE]

Short theme description: This theme focused on the role of the regional CE hubs (networks) which emerged as particularly important stakeholder and pressure which could provide real boost to the CE adoption in the EU territories. The concept of transition broker as professional figure and circular diplomacy were one of the most novel keywords transpiring from the interviews.

9.1 Regional circular economy hubs (networks)

- 9.1.1 Existing efforts not recorded in literature yet
- 9.1.2 Existing dialog with the EU within the ECESP
- 9.1.3 Organised as public-private partnership
 - 9.1.3.1 Ensure political independence
 - 9.1.3.2 Perpetuity of initiatives and resources
 - 9.1.3.3 Partnership with skilled public servant within the regional authorities
 - 9.1.3.4 Support data collection for measurement/monitoring initiatives
 - 9.1.3.5 Speak with companies with the voice of privates
- 9.1.4 Vital role of EU in supporting the establishment of CE hubs
 - 9.1.4.1 Financial support
 - 9.1.4.2 Particular support to territories with lower democratic index

9.2 National circular economy hubs (networks)

- 9.2.1 Play bigger role on internalisation (circular diplomacy)

9.3 Transition broker

- 9.3.1 Leading the circular hub
- 9.3.2 Professional figure in the middle of the Quadruple helix
- 9.3.3 Focus on the transition, with day-today business enabling communication between actors
- 9.3.4 Improve connectivity among actors on the territory
 - 9.3.4.1 Aligned with the place-based approach
 - 9.3.4.2 Organise networking moments
 - 9.3.4.3 Liaise with SMEs
- 9.3.5 Coordinate circular vouchers instruments
 - 9.3.5.1 Facilitate negotiation between company & advisor
- 9.3.6 Ensure coexistence & constant dialogue between network governance & public governance
- 9.3.7 Circular diplomacy – role of internationalisation
 - 9.3.7.1 Keep the hub connected to the global dimension
 - 9.3.7.2 Think globally, act locally concept
 - 9.3.7.3 Circular diplomacy group at the EU level

10. Regional frameworks for measuring and monitoring CE progress [CODE]

Short theme description: This theme focused on the regional frameworks and efforts for both measuring and monitoring the CE progress, trying to capture the distinction between the two activities. Additionally, it focused on the main difficulties pointed out by the participants for

the measuring of CE transition, along with the major regional data availability issues. Several solutions to address these issues were also provided.

- 10.1 Monitoring vs. measuring vagueness of frontiers
 - 10.1.1 Regional measurement framework (measuring output)
 - 10.1.1.1 Material flows & material footprint
 - 10.1.1.1.1 Shift of focus from emissions/outputs to major extraction materials/resources
 - 10.1.1.2 Material Flow Accounting (MFA)
 - 10.1.1.2.1 Only way to measure % of circularity
 - 10.1.1.3 Multi-regional input-output (MRIO) method
 - 10.1.1.4 Focus on generally accepted measurement
 - 10.1.1.5 Internal measurement & reporting
 - 10.1.1.6 Lack of measurement framework
 - 10.1.1.7 Doubts in reliability of existing frameworks
 - 10.1.1.8 Measurement framework developed within regional CE policy
 - 10.1.2 Regional monitoring framework (measuring input)
 - 10.1.2.1 Monitoring of activities/initiatives
 - 10.1.2.2 Project-based monitoring
 - 10.1.2.2.1 Internal monitoring of:
 - 10.1.2.2.1.1 Number of projects dealing with CE solutions
 - 10.1.2.2.1.2 Number of enterprises receiving funding
 - 10.1.2.2.1.3 Funds received
 - 10.1.2.2.1.4 Derived investment from received funds
 - 10.1.2.3 Monitoring mechanisms for EU funds
 - 10.1.2.3.1 National controls
 - 10.1.2.3.2 EU (audit) control
 - 10.1.2.4 Lack of monitoring framework
 - 10.1.2.5 National CE monitoring framework
- 10.1.3 Common denominators for both frameworks
 - 10.1.3.1 Need for transparency of existing frameworks
 - 10.1.3.2 Measurement & monitoring as prerequisite for informed decision making
 - 10.1.3.2.1 Importance of proper monitoring mechanisms
 - 10.1.3.2.2 Ensure direction and speed of implementation for target attainment
 - 10.1.3.2.3 Need for periodic adjustments
 - 10.1.3.3 Wider efforts for regional monitoring & measuring of CE progress
 - 10.1.3.3.1 Intra-country
 - 10.1.3.3.2 Inter-country
 - 10.1.3.4 Links between measuring & monitoring of CE transition
 - 10.1.3.4.1 Design upcoming projects & funding opportunities

- 10.2 Difficulties in regional CE measurement
 - 10.2.1 Ambiguity in scope
 - 10.2.1.1 CE as too narrow trend to be measured
 - 10.2.1.1.1 To be seen through the broader sustainability transition lens
 - 10.2.2 Shift from backward to forward looking measurement frameworks
 - 10.2.2.1 Caveats of measuring baseline scenarios
 - 10.2.2.2 Concentrate on measuring progress in design phase
 - 10.2.3 Inability to capture the impact of CE
 - 10.2.3.1 Existing industrial activities & initiatives not recorded
 - 10.2.4 Inability to capture shift from old to new business models
 - 10.2.5 Underrepresentation of social dimension
 - 10.2.6 Standardisation issue
 - 10.2.7 Missing data framework for measuring CE transition
 - 10.2.7.1 Intention for devising data framework within RIS3
 - 10.2.7.2 Need for new metrics to evaluate transformative processes
 - 10.2.7.3 Lack of an integrated measuring framework
 - 10.2.8 Fragmented & uncoordinated efforts
 - 10.2.8.1 For data collection
 - 10.2.8.2 For data processing
 - 10.2.9 Lack of regional capacities to develop policy intelligence for:
 - 10.2.9.1 Developing indicators
 - 10.2.9.2 Informed use of the developed indicators
 - 10.2.9.3 Evidence-based policymaking
- 10.3 Regional data availability issue
 - 10.3.1 Focus on waste-related data mostly
 - 10.3.1.1 Waste - regional competence in some MS
 - 10.3.1.2 Historical (backwards looking) only
 - 10.3.1.3 Fast vs. slow-moving loops
 - 10.3.2 Lack of regional data (scale issues)
 - 10.3.2.1 Existence of national data that needs to be disaggregated
 - 10.3.2.2 Existence of municipal data that needs to be aggregated
 - 10.3.2.3 Centralised statistical systems
 - 10.3.3 Very specific metrics - hard to develop and sustain input
 - 10.3.4 Reluctance of companies to supply financial data
 - 10.3.5 Data reliability issue
 - 10.3.5.1 Data delivered not on quality
 - 10.3.6 Lack of detailed data
 - 10.3.7 Lack of innovative approaches being adopted
 - 10.3.8 Laggard feature of statistics

- 10.4 Addressing regional data availability issue
 - 10.4.1 Set realistic targets that could be attained
 - 10.4.2 Involvement of academic actors
 - 10.4.2.1 In data collection
 - 10.4.2.2 In measurement efforts
 - 10.4.3 Regulatory compliance to induce data collection
 - 10.4.3.1 Corporate sustainability reporting
 - 10.4.4 EU general guidelines & regional data framework
 - 10.4.4.1 Risk of adverse impact (extra layer of boreoarctic obligations)
 - 10.4.4.2 Enable comparison between regions
 - 10.4.4.3 Support regions through CCRI CSO consortium
 - 10.4.5 Develop frameworks via projects
 - 10.4.5.1 Interregional EU projects
 - 10.4.5.2 Regional projects
 - 10.4.6 The role of circular hubs as public-private network for data collection
 - 10.4.7 Utilise innovative approaches and available advanced technologies for data collection and generation
 - 10.4.7.1 Leverage on the twin transition (digitalisation)
 - 10.4.7.2 Identify and leverage on areas with existing data
 - 10.4.8 Cooperation with national level for data collection & framework refinement
 - 10.4.9 Ensure sequence & perpetuity between political cycles
 - 10.4.10 Attempts to regionalise broader sustainability indicators
 - 10.4.10.1 JRC resilience dashboard

Appendix I: Example of coded Transcripts for Template Analysis

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Appendix J: Policy Brief

Implementing Circular Economy Policies: a European regional perspective

Summary

A transformative system-wide change is needed for effective implementation of the Circular Economy (CE). This includes the precondition of working across governmental levels, territorial scales, policy areas, and sectoral boundaries. Equally important is the broad and profound mobilisation, involvement, and alignment of stakeholders. Furthermore, the CE transition will entail a place-based perspective, as each region will transition in a territorially differentiated manner. Therefore, policy actions directed towards local factors are crucial for establishing and maintaining an institutional environment which is supportive of CE-based transformations. Smart Specialisation Strategies (S3), regarded as a tactical element in the formulation of investment flows and regional CE supply chains, are anticipated to have a major role towards regional development, cohesion, and green transition in the 2021-2027 programming period.

Policy Implications

1. The regional narrative in the CE transition.

Meticulous analysis of the **regional narrative** is the starting point for transitioning towards CE, as each region will transition in a territorially differentiated manner. Therefore, careful consideration of the **regional structural aspects** is indisputably a precondition, entailing on one hand the **place-based approach** anchored on regional strengths, but simultaneously considering the **challenges** the region is facing along with the emerging **opportunities** on which the region can leverage on. The role and importance of regions was overall recognised throughout the whole policy Delphi study, and it was perceived through two different viewpoints – considering the territorial level of policy implementation and the perspective of a regional authority. When it comes to the latter, we identified a tendency for **organisational transformation at the level of regional administration**, shifting the focus towards challenges and transitioning themes. The **institutional structure and overall prevailing mentality** in regional authorities proved to be vital for the development and adoption of CE policies, because collaboration and trust required to undertake CE initiatives are fostered locally. The importance of having **well developed capacity and leadership skills** at the regional level to envisage long-term vision and actions was also stressed. In this context, it is crucial that regional authorities are feeling agency over their own future. **Regional autonomy** is another important determinant, which is being reflected in a rather fragmented legislative landscape within the EU. **Balanced distribution of power between formal and informal players** was deemed as ideal, ensuring harmonious symbiosis between central government and local level. In that respect, the need of having a unified narrative towards the CE transition through the existence of a functional and efficient multi-level governance mechanism, including **vertical and horizontal governance**, **seems imperative**, along with maximisation of interplay between governance levels.

2. Institutional pressures driving the regional CE policy formulation and implementation

The influence of **legislative, normative, and mimetic pressures** on the formulation and adoption of regional CE policies was investigated. The legally binding nature of the international and EU legislation was justifying the predominance of this pressure in the legislative group of pressures, representing a top-down approach. The low influence of the pertinent regional legislation was stressed as an issue, which should **ring a bell to the transposition process**. The regional stakeholders representing the regional eco-system was the predominant driver on the normative side, indicating bottom-up approach. The EU funding programmes appear to be more influential in poorer Member States (MS) and regions, compared to richer territories. In terms of mimetic pressures, the exchange of best practices within EU projects and networks seems to be important, along with the mimetic pressure coming from leading regions in the area of CE and neighbouring regions. However, there is a **need to shift the relative importance of normative and mimetic pressures** in the future, as well as

increase the influence of national and regional legislation. The central question in that respect is – “what kind of changes might help shift that?”

3. Formulation and implementation of regional CE policies

Overall, the **configuration of the CE policies** within EU regions appears to be **wide and diverse**, ranging from no policies in place (but scattered CE activities undertaken within the region), to existence of a standalone CE strategy, action plan, or wider sustainability agendas which entail CE elements. Similarly, the **initiation of regional CE policies** seems to be **diverse**, some following top-down conditionality, while others being initiated on an initiative of the regional government. In terms of **stages of implementation of the CE policies**, the picture was also **scattered**; on one hand we identified regions where CE was perceived as business as usual and the CE concept has penetrated in wide range of existing regional policies, while on the other, we found regions not knowing from where to start from. Overall, a **balanced approach for implementation** is needed, implying the necessity to increase the interaction between the top-down and bottom-up initiative, ensuring both efforts are moving in the same direction. CE policies, being one of the main building blocks of the EU Green Deal (EUGD), are facing some common challenges which should be carefully considered. This includes the question of **green readiness** and **the risk of the Matthew effect**, as well as the reality check implied with the EUGD going local. Due to the current sectoral approach of policy implementation, a **bottleneck is being created at the regional level**, and regions are facing growing challenges in addressing these changes in a productive way. The big concern is whether these changes are addressed in a reactive, or a negative way, manifested by outmigration and stagnated regional performance. Additionally, the Green Deal debate is perceived as being very much a **big city debate and not a regional one**, because **aspects of place and distance are not on the EUGD radar** and regions with production capacities are facing bigger challenges compared to consumption driven cities. Nevertheless, the main question remains to be whether the **EUGD and CE can act as potential accelerator of the divide** and widen the existing gap between **North vs. South Europe**, creating a **two-speed Europe**. However, the distinction between the **advanced (frontrunning) regions** and the **lagging behind (weaker) regions** in the CE transition was acknowledged.

4. S3 and CE nexus

The Smart Specialisation Strategies (S3) are another significant variable influencing the development and adoption of the regional CE policies, where a **mutual interaction** between the two policies was uncovered. A **less deterministic relationship** appears to exist with several **risks of adverse influence**, including **risks of regional lock-ins in linear supply chains and potential negative path-dependency situation**, underlined. The possibility of S3 and CE having both positive and negative influence was presented through the prism of **trade-offs and complementarities**, where the success parameter is whether CE activities can be applied at scale, over long-term commitments in lagging behind regions, and not just in economically advanced territories. Another determinant is based on **how regions interpreted S3**, which in turn influenced how **efficient (or inefficient) links were established between S3 and CE** afterwards. Namely, the distinction was made between regions that have been **interpreting S3 narrowly**, perceiving it as a regulatory obligation and administrative procedure to obtain EU funds, and regions that have **captured S3 as transformative strategy** incorporating innovative approaches, therefore comprehending the strategic aspect behind the strategy. The **constellation of stakeholders** also proved as vital in determining the nature of the relationship between the two policies. Ultimately, the **monopolistic situation where key industrial players are dominating** the transition needs to be avoided, and **inclination towards a more ecosystem configuration** needs to be ensured. Some of the main reasons for regional lock-in encompass **the tensions due to the incumbent structures and networks confrontation** and the risk of **key industrial players** in unsustainable core industries **lobbying and monopolising the CE agenda**. However, the most important one was inherited in the **S3 heuristic**, where **prioritisation in areas of strengths is often defined in unsustainable activities**. A most prominent example are the regions with **Natural Resource-Based Industries (NRBIs)**, like coal regions, which in their S3 identified priority areas very close to unsustainable activities, now due to be phased out by 2030 because of EU legal commitments. Certain **risk mitigation mechanisms** were proposed, among which, some within the context of the Partnerships for Regional Innovation (PRI) initiative were promising.

5. Regional CE hubs (networks)

The vital role of the regional CE hubs (networks) in the formulation and implementation of CE policies within EU regions, was also highlighted, as another normative pressure which can certainly boost the CE transition. Ideally **organised as public-private partnerships**, the regional CE hubs will be steered by a **‘transition broker’** as a professional figure in the middle of

the Quadruple helix model that should bridge stakeholders together, leading the day-to-day business, while keeping in mind the transition. Another evolving role of the 'transition broker' is to promote the **circular diplomacy and internationalisation of the region**, keeping the hub connected to the global dimension, but focusing on local implementation.

6. Partnerships for Regional Innovation (PRI) initiative

The potential of the PRI initiative to provide a framework that is **more receptive to transformation**, where it is most needed, particularly in lagging territories was acknowledged, despite being still in the co-creation phase. Hence, it can **introduce a new heuristic accenting sustainable development** that is not based solely on regional strengths, but also on **regional challenges and opportunities to be grasped throughout innovation**, acting as a mitigation mechanism to address the risk inherited in the S3 on the one side and contributing to the transition world with development of regional transitional strategies, engaging different policies.

7. Tracking regional performance

The measurement and monitoring of regional performance were perceived as **prerequisite for informed decision making**, safeguarding that the **direction and speed of goal attainment chosen** are the right ones. The invested activities, initiatives and financial resources should be measured on **the input side**, while the % of circularity of the region should be presented on the **output side**. Certainly, these two sides of the coin should be in constant interaction, with **periodic adjustments and revision mechanisms**, to account for latest developments and adjust policies and instruments. Additionally, the regional monitoring framework should be **ecologically sensitive, suitable for driving a socio-ecological transition**, therefore monitoring activities and results related to **economic, social, and environmental aspects**. However, a wide range of **difficulties related to the measurement and monitoring** of the CE transition have been reported in the EU regions, along with **major regional data availability issues**, which was one of the main obstacles underlined throughout the study. Some courses of action and potential initiatives were proposed in order to address this, the most promising being the **leverage on the twin transition**, by utilising innovative approaches and available advanced technologies both for data collection and generation.

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References

#upperVISION2030 (2020). Available at: <https://www.uppervision.at/en/the-programme>

2020 European Social Progress Index, EU-SPI (2020). Available at: https://ec.europa.eu/regional_policy/en/information/maps/social_progress2020/#3

Abrizah, A.; Zainab, A. N.; Kiran, K.; Raj, R. G. (2013). LIS journals scientific impact and subject categorisation: a comparison between Web of Science and Scopus, *Scientometrics*, 94 (2), 721-740.

Action Plan for promotion of the circular economy in SMEs of the Region of Central Macedonia (2018). Available at: https://projects2014-2020.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1544096220.pdf

Action Plan: Towards Bio-Based Circular Economy (2019). Available at: https://www.interregeurope.eu/fileadmin/user_upload/tx_tevprojects/library/file_1572349960.pdf

- Adom, D., Hussein, E., Adu-Agyem, J. (2018). Theoretical and conceptual framework: mandatory ingredients of a quality research. *International Journal of Scientific Research*. 7. 438-441.
- Agovino, M., Cerciello, M., & Musella, G. (2019). The good and the bad: Identifying homogeneous groups of municipalities in terms of separate waste collection determinants in Italy. *Ecological Indicators*, 98, 297–309.
<https://doi.org/10.1016/j.ecolind.2018.11.003>
- Agovino, M., Ferrara, M., Marchesano, K., & Garofalo, A. (2020). The separate collection of recyclable waste materials as a flywheel for the circular economy: the role of institutional quality and socio-economic factors. *Economia Politica*, 37(2), 659–681.
<https://doi.org/10.1007/s40888-019-00153-9>
- Alaerts, L., Van Acker, K., Rousseau, S., De Jaeger, S., Moraga, G., Dewulf, J., ... Eyckmans, J. (2019). Towards a more direct policy feedback in circular economy monitoring via a societal needs perspective. *Resources, Conservation and Recycling*, 149, 363–371.
<https://doi.org/10.1016/j.resconrec.2019.06.004>
- Alasuutari, P. (2015). The discursive side of new institutionalism. *Cultural Sociology*, 9(2), 162–184. <https://doi.org/10.1177/1749975514561805>
- Allen, S. D., Zhu, Q., & Sarkis, J. (2021). Expanding conceptual boundaries of the sustainable supply chain management and circular economy nexus. *Cleaner Logistics and Supply Chain*, 2, 100011. <https://doi.org/https://doi.org/10.1016/j.clscn.2021.100011>
- Alonso-Almeida, M. D. M., & Rodríguez-Antón, J. M. (2020). The role of institutional engagement at the macro level in pushing the circular economy in Spain and its regions. *International Journal of Environmental Research and Public Health*, 17(6), 1–24.
<https://doi.org/10.3390/ijerph17062086>
- Amenta, L., & Qu, L. (2020). Experimenting with circularity when designing contemporary regions: Adaptation strategies for more resilient and regenerative metropolitan areas of Amsterdam and Naples developed in university studio settings. *Sustainability (Switzerland)*, 12(11). <https://doi.org/10.3390/su12114549>
- Andrea Genovese & Mario Pansera (2020). The Circular Economy at a Crossroads: Technocratic Eco-Modernism or Convivial Technology for Social Revolution?, *Capitalism Nature Socialism*, DOI: [10.1080/10455752.2020.1763414](https://doi.org/10.1080/10455752.2020.1763414)
- Andrés Rodríguez-Pose (2013). Do Institutions Matter for Regional Development? *Regional Studies*, 47(7), 1034-1047, DOI: 10.1080/00343404.2012.748978
- Andretta, A., D'addato, F., Serrano-Bernardo, F., Zamorano, M., & Bonoli, A. (2018). Environmental taxes to promote the eu circular economy's strategy: Spain vs. Italy. *Environmental Engineering and Management Journal*, 17(10), 2307–2311.
<https://doi.org/10.30638/eemj.2018.229>

- Andrews, Rhys & Bellò, Benedetta & Downe, James & Martin, Steve & Walker, Richard. (2021). The Motivations for the Adoption of Management Innovation by Local Governments and its Performance Effects. *Public Administration Review*, 81. 10.1111/puar.13375.
- Aranda-Usón, A., M. Moneva, J., Portillo-Tarragona, P., & Llana-Macarulla, F. (2019). Measurement of the circular economy in businesses: Impact and implications for regional policies. *Economics and Policy of Energy and the Environment*, (2), 187–205. <https://doi.org/10.3280/efe2018-002010>
- Aranda-Usón, A., Portillo-Tarragona, P., Scarpellini, S., & Llana-Macarulla, F. (2020). The progressive adoption of a circular economy by businesses for cleaner production: An approach from a regional study in Spain. *Journal of Cleaner Production*, 247. <https://doi.org/10.1016/j.jclepro.2019.119648>
- Arbolino, R., Boffardi, R., & Ioppolo, G. (2020). An insight into the Italian chemical sector: How to make it green and efficient. *Journal of Cleaner Production*, 264, 121674. <https://doi.org/10.1016/j.jclepro.2020.121674>
- Arbolino, R., De Simone, L., Carlucci, F., Yigitcanlar, T., & Ioppolo, G. (2018). Towards a sustainable industrial ecology: Implementation of a novel approach in the performance evaluation of Italian regions. *Journal of Cleaner Production*, 178, 220–236. <https://doi.org/10.1016/j.jclepro.2017.12.183>
- Arsova, S., Genovese, A., and Ketikidis, P. H. (2022). Implementing circular economy in a regional context: A systematic literature review and a research agenda. *Journal of Cleaner Production*, 368, 133117. <https://doi.org/https://doi.org/10.1016/j.jclepro.2022.133117>
- Arsova, S., Genovese, A., Ketikidis, P. H., Alberich, J. P., Solomon, A. (2021). Implementing Regional Circular Economy Policies: A Proposed Living Constellation of Stakeholders. *Sustainability*, 13, 4916. <https://doi.org/10.3390/su13094916>
- Arsova, S., Corpakis, D., Genovese, A., Ketikidis, P.H. (2021a). The EU green deal: Spreading or concentrating prosperity? Resources, Conservation and Recycling, 171, 105637. <https://doi.org/10.1016/j.resconrec.2021.105637>.
- Arsova, S., Genovese, A., Georgantzis-Garcia, D., Ketikidis, P.H., Solomon, A. (2021b). *Identification of drivers and barriers for the implementation of regional Circular Economy policies*. ReTraCE Project Deliverable D4.4. Available at: <http://www.retrace-itn.eu/wp-content/uploads/2021/04/ReTraCE-D4.4.pdf>
- Arsova, S., Genovese, A., Georgantzis-Garcia, D., Ketikidis, P.H., Kipnis, E., Lowe, B., Solomon, A., Yoon, M. (2020). *Measuring the transition towards a Circular Economy at a regional level: a review*. ReTraCE Project Deliverable D4.3. Available at: <http://www.retrace-itn.eu/wp-content/uploads/2020/07/ReTraCE-D4.3.pdf>

- Arsova, S., Genovese, A., Georgantzis-Garcia, D., Kennedy, S., Solomon, A., Ketikidis, P.H., Yoon, M. (2020a) *Circular Economy Implementation at a Regional Level: A Preliminary Review*. ReTraCe Project Deliverable D4.1. Available online: <http://www.retrace-itn.eu/wp-content/uploads/2020/04/ReTraCE-D4.1.pdf> (accessed on 11 January 2021)
- Ashworth, Rachel, George A. Boyne, and Rick Delbridge (2009). Escape from the Iron Cage? Organisational Change and Isomorphic Pressures in the Public Sector. *Journal of Public Administration Research and Theory*, 19(1), 165–87
- Avdiushchenko, A. (2018). Toward a Circular Economy Regional Monitoring Framework for European Regions: Conceptual Approach. *Sustainability*, 10(12), 4398. <https://doi.org/10.3390/su10124398>
- Avdiushchenko, A., & Zajač, P. (2019). Circular economy indicators as a supporting tool for european regional development policies. *Sustainability (Switzerland)*, 11(11), 1–22. <https://doi.org/10.3390/su11113025>
- Bacova, M., Bohm, K., Guitton, M., Herwijnen, M., van, Kallay, T., Koutsomarkou, J., Magazzù, I., O'Loughlin, E., Rok, A., (2016). *Pathways to a Circular Economy in Cities and Regions*.
- Banaite, D., & Tamošiuniene, R. (2016). Sustainable development: The circular economy indicators' selection model. *Journal of Security and Sustainability Issues*, 6(2), 315–323. [https://doi.org/10.9770/jssi.2016.6.2\(10\)](https://doi.org/10.9770/jssi.2016.6.2(10))
- Banias, G., Batsioulas, M., Achillas, C., Patsios, S. I., Kontogiannopoulos, K. N., Bochtis, D., & Moussiopoulos, N. (2020). A life cycle analysis approach for the evaluation of municipal solid waste management practices: The case study of the region of central macedonia, greece. *Sustainability (Switzerland)*, 12(19). <https://doi.org/10.3390/su12198221>
- Bar-Ilan, J. (2010). Citations to the “Introduction to informetrics” indexed by WOS, Scopus and Google Scholar, *Scientometrics*, 82 (3), 495-506.
- Barbero, S., & Pallaro, A. (2018). Systemic design and policy making. *FormAkademisk - Forskningstidsskrift for Design Og Designdidaktikk*, 11(4), 1–13. <https://doi.org/10.7577/formakademisk.2219>
- Basque Country Circular Economy Strategy 2030 (2020). Available at: <https://www.euskadi.eus/documentacion/2020/estrategia-de-economia-circular-de-euskadi-2030/web01-a2ingkut/es/>
- Bell, E., Bryman, A., & Harley, B. (2018). *Business research methods*. Oxford university press.
- Benchmarking Regional Structure. Available at: <https://s3platform.jrc.ec.europa.eu/regional-benchmarking>

- Bergman, N., Markusson, N., Connor, P., Middlemiss, L., Ricci, M. (2010). *Bottom-up, Social Innovation for Addressing Climate Change*. Paper presented at Sussex Energy Group Conference, Brighton, UK.
- Bettencourt, L. et al. (2007). *Growth, Innovation, Scaling, and the Pace of Life in Cities*, <http://dx.doi.org/10.1073/pnas.0610172104>.
- Bezama, A., Ingrao, C., O'Keeffe, S., & Thrän, D. (2019). Resources, collaborators, and neighbours: The three-pronged challenge in the implementation of bioeconomy regions. *Sustainability (Switzerland)*, 11(24). <https://doi.org/10.3390/su11247235>
- Bianchi, M., Tapia, C., & del Valle, I. (2020). Monitoring domestic material consumption at lower territorial levels: A novel data downscaling method. *Journal of Industrial Ecology*, 24(5), 1074–1087. <https://doi.org/10.1111/jiec.13000>
- Bilz, K., Nadler, J. (2014). Law, moral attitudes and behavioral change. *The Oxford Handbook of Behavioral Economics and the Law*, 241–267.
- Boffardi, R., De Simone, L., De Pascale, A., Ioppolo, G., & Arbolino, R. (2021). Best-compromise solutions for waste management: Decision support system for policymaking. *Waste Management*, 121, 441–451. <https://doi.org/10.1016/j.wasman.2020.12.012>
- Borghetto, E., and Franchino, F. (2010). The role of subnational authorities in the implementation of EU directives. *Journal of European Public Policy*, 17(6), 759–780. <https://doi.org/10.1080/13501763.2010.486972>
- Boulding, K. (1966). The economics of the coming spaceship earth. In *Environmental Quality in a Growing Economy: Essays from the Sixth RFF Forum*; Jarrett, H., Ed.; John Hopkins University Press: Baltimore, MD, USA, 3–14.
- Brand, E., & De Bruijn, T. (1999). Shared responsibility at the regional level: The building of sustainable industrial estates. *European Environment*, 9(6), 221–231. [https://doi.org/10.1002/\(SICI\)1099-0976\(199911/12\)9:6<221::AID-EET209>3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1099-0976(199911/12)9:6<221::AID-EET209>3.0.CO;2-Z)
- Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology, *Qualitative Research in Psychology*. 3(2), 309-325.
- Brooks, J., McCluskey, S., Turley, E., & King, N. (2015). The Utility of Template Analysis in Qualitative Psychology Research. *Qualitative research in psychology*, 12(2), 202–222. <https://doi.org/10.1080/14780887.2014.955224>
- Brooks, Joanna and King, Nigel (2014). Doing Template Analysis: Evaluating an End of Life Care Service. *Sage Research Methods Cases*.
- Brussels Regional Program for a Circular Economy 2016 – 2020 (BRPCE) (2016). Available at: <https://www.circulareconomy.brussels/a-propos/le-prec/?lang=en>
- Bryman, A., Bell, E. (2015). *Business research methods*. Oxford University Press, USA.

- Campbell-Johnston, K., de Munck, M., Vermeulen, W. J. V., & Backes, C. (2021). Future perspectives on the role of extended producer responsibility within a circular economy: A Delphi study using the case of the Netherlands. *Business Strategy and the Environment*, 1–14. <https://doi.org/10.1002/bse.2856>
- Cappellaro, F., Fantin, V., Barberio, G., & Cutaia, L. (2020). Circular economy good practices supporting waste prevention: The case of Emilia-Romagna Region. *Environmental Engineering and Management Journal*, 19(10), 1701–1710. <https://doi.org/10.30638/eemj.2020.160>
- Carayannis, E.G., Campbell, D.F., (2012). Mode 3 knowledge production in quadruple helix innovation systems. In: Mode 3 Knowledge Production in Quadruple Helix Innovation Systems. *Springer New York*, 1-63. https://doi.org/10.1007/978-1-4614-2062-0_1.
- Castells-Quintana, David & Royuela, Vicente & Veneri, Paolo. (2020). Inequality and city size: An analysis for OECD functional urban areas. *Papers in Regional Science*. 99. 10.1111/pirs.12520.
- Cavaleiro de Ferreira, A., and Fuso-Nerini, F. (2019). A Framework for Implementing and Tracking Circular Economy in Cities: The Case of Porto. *Sustainability*, 11(6), 1813.
- Chadegani, A. A.; Salehi, H.; Yunus, M. Md; Farhadi, H.; Fooladi, M.; Farhadi, M.; Ebrahim, N. A. (2013). A Comparison between Two Main Academic Literature Collections: Web of Science and Scopus Databases. *Asian Social Science*, 9 (5), 1911-2025.
- Chertow, M., Ehrenfeld, J. (2012). Organising self-organising systems. *Journal of Industrial Ecology*, 16, 13-27.
- Chertow, M.R., Lifset, R. (2008). Industrial Symbiosis, the Encyclopedia of Earth. Available at: http://www.eoearth.org/article/Industrial_symbiosis. accessed September 2012.
- Christis, M., Athanassiadis, A., & Vercalsteren, A. (2019). Implementation at a city level of circular economy strategies and climate change mitigation – the case of Brussels. *Journal of Cleaner Production*, 218, 511–520. <https://doi.org/10.1016/j.jclepro.2019.01.180>
- Circle Economy (2020). *The Circularity Gap Report 2020*. Available at: <https://www.circularity-gap.world/2020#interactive> [Accessed 10th May 2020].
- CIRCTER (2019). *Circular Economy and Territorial Consequences – Policy Guide*. ESPON. Available at: https://www.espon.eu/sites/default/files/attachments/CIRCTER%20Policy%20guide_0.pdf [Accessed 15th May 2020].
- Circulair Fryslân: De Economie Van De Toekomst (2015). Available at: <https://www.fryslan.frl/circulaireconomie>
- Circular Economy Regional Law n.16/2015 (2015). Available at: <https://ambiente.regione.emilia-romagna.it/it/rifiuti/temi/rifiuti/economia-circolare>

- Circular Economy Strategy Luxembourg (2021). Available at: <https://economie-circulaire.public.lu/en/publications/circular-strategy.html>
- Circular Economy Strategy Luxembourg (2021). Available at: <https://economie-circulaire.public.lu/en/publications/circular-strategy.html>
- Circular Flanders. Available at: <https://vlaanderen-circulair.be/en>
- Circular Friesland. Available at: <https://circulairfriesland.frl/>
- Circular Madeira 2030 (2021). Available at: <https://madeiracircular.pt/regulamentacao>
- Circular Prague 2030 (2022). Available at: https://portalzp.praha.eu/jnp/cz/odpady/predchazeni_vzniku_odpadu/strategie_HMP_pro_prechod_na_cirkul_ekonomiku_2030.html
- Circular Wallonia, circular economy deployment strategy (2021). Available at: <https://economiecirculaire.wallonie.be/situation-regionale>
- Cities in Action – BRPCE (2017). Regional programme defines and drives action for change. Available at: https://use.metropolis.org/system/images/2088/original/cooperation_Brussels.pdf
- Commission of European Communities (2014). Communication No. 130, 2014. Taking stock of the Europe 2020 strategy for smart, sustainable and inclusive growth (COM no. 130, 2014).
- Compagnoni, M. (2020). Regional policies for circular economy in Italy and an empirical analysis of pay-as-you-throw tax effects in emilia romagna. *Environmental Engineering and Management Journal*, 19(10), 1711–1718. <https://doi.org/10.30638/eemj.2020.161>
- CoR (European Committee of the Regions) (2019). *Implementing a place-based approach to EU industrial policy strategy*. Available at: https://cor.europa.eu/en/engage/studies/Documents/CoR_Industry.pdf [Accessed 17th May 2020].
- Corona, B., Shen, S., Reike, D., Carreón, J.R., Worrell, E. (2019). Towards sustainable development through the circular economy - A review and critical assessment on current circularity metrics. *Resources, Conservation and Recycling*, 151, Article 104498.
- Cossu, R., Sciunnach, D., Cappa, S., Gallina, G., Grossule, V., & Raga, R. (2020). First worldwide regulation on sustainable landfilling: Guidelines of the Lombardy region (Italy). *Detritus*, 12, 114–124. <https://doi.org/10.31025/2611-4135/2020.14001>
- Costa, I., Massard, G., Agarwal, A. (2010). Waste management policies for industrial symbiosis development: case studies in European countries. *Journal of Cleaner Production*, 18 (8), 815-822.

- Council of the European Union (2019). *More circularity - Transition to a sustainable society - Council conclusions*. 12791/19, Brussels.
- Cramer, J. M. (2020). The function of transition brokers in the regional governance of implementing circular economy - A comparative case study of six dutch regions. *Sustainability (Switzerland)*, 12(12). <https://doi.org/10.3390/su12125015>
- Cutaia, L., Luciano, A., Barberio, G., Sbaffoni, S., Mancuso, E., Scagliarino, C., & La Monica, M. (2015). The experience of the first industrial symbiosis platform in Italy. *Environmental Engineering and Management Journal*, 14(7), 1521–1533. <https://doi.org/10.30638/eemj.2015.164>
- D'Adamo, I., Falcone, P. M., Imbert, E., & Morone, P. (2020). Exploring regional transitions to the bioeconomy using a socio-economic indicator: the case of Italy. In *Economia Politica*. <https://doi.org/10.1007/s40888-020-00206-4>
- Dąbrowski, M., Varjú, V., & Amenta, L. (2019). Transferring circular economy solutions across differentiated territories: Understanding and overcoming the barriers for knowledge transfer. *Urban Planning*, 4(3), 52–62. <https://doi.org/10.17645/up.v4i3.2162>
- Daddi, T., Iraldo, F., Frey, M., Gallo, P., & Gianfrate, V. (2016). Regional policies and eco-industrial development: The voluntary environmental certification scheme of the eco-industrial parks in Tuscany (Italy). *Journal of Cleaner Production*, 114, 62–70. <https://doi.org/10.1016/j.jclepro.2015.04.060>
- Datta, Ayona. (2012). 'India's Ecocity? Environment, Urbanisation, and Mobility in the Making of Lavasa.' *Environment and Planning C: Government and Policy*. 30 (6), 982–996. <https://doi:10.1068/c1205j>
- De Jesus, A. and Mendonça, S. (2018). Lost in Transition? Drivers and barriers in the eco-innovation road to the circular economy. *Ecological Economics*. 145, 75-89. <https://doi.org/10.1016/j.ecolecon.2017.08.001>
- De Jesus, A., Antunes, P., Santos, R. and Mendonça, S. (2019). Eco-innovation pathways to a circular economy: Envisioning priorities through a Delphi approach. *Journal of Cleaner Production*. 228. 10.1016/j.jclepro.2019.04.049.
- de Oliveira, U. R., Espindola, L. S., da Silva, I. R., da Silva, I. N., & Rocha, H. M. (2018). A systematic literature review on green supply chain management: research implications and future perspectives. *Journal of Cleaner Production*. doi:10.1016/j.jclepro.2018.03.083
- del Mar Alonso-Almeida, M., Rodriguez-Anton, J. M., Bagur-Femenías, L., & Perramon, J. (2021). Institutional entrepreneurship enablers to promote circular economy in the European Union: Impacts on transition towards a more circular economy. *Journal of Cleaner Production*, 281, 124841.

- Demaria, F., Schneider, F., Sekulova, F. and Martinez-Alier, J. (2013). What Is Degrowth? From an Activist Slogan to a Social Movement. *Environmental Values*. 22 (2), 191–215. doi:10.3197/096327113X13581561725194.
- DiMaggio, P.J., Powell, W.W. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organisational Fields. *Am. Sociol. Rev.* 48, 147.
- Division of Powers. Available at:
<https://portal.cor.europa.eu/divisionpowers/Pages/default.aspx>
- Dixon, Ruth, and Thomas Elston. (2020). Efficiency and Legitimacy in Collaborative Public Management: Mapping Inter-Local Agreements in England Using Social Network Analysis. *Public Administration*, 98(3), 746–67
- Drejerska, N., Vrontis, D., Siachou, E., & Golebiewski, J. (2020). System solutions for the circular economy on the regional level: the case of Green Lungs of Poland. *Journal of Global Business Advancement*, 13(4), 447-468.
- East and North Finland in industrial transition - smart specialisation strategy 2019-2023 (2019). Available at: <https://elmoenf.eu/>
- EC (2020), *A New Circular Economy Action Plan for a Cleaner and More Competitive Europe*, European Commission.
- Eca (2020). *Impact of Shift to Circular Economy*, European Commission
- Ecb (2020). *2030 Climate & Energy Framework*, European Commission, Available at: https://ec.europa.eu/clima/policies/strategies/2030_en
- Elia, V., Grazia Gnoni, M., Tornese, F. (2017). Measuring circular economy strategies through index methods: A critical analysis. *Journal of Cleaner Production*, 142, 2741–2751.
- Ellen MacArthur Foundation (2019). *Completing the Picture: How the Circular Economy Tackles Climate Change*.
- Ellen MacArthur Foundation. *Circulytics - measuring circularity* (No Date.) Available at: <https://www.ellenmacarthurfoundation.org/resources/apply/circulytics-measuring-circularity> [Accessed 30th May 2020].
- EOI (2016). Eco-Innovation Observatory - Policies and Practices for Eco-Innovation Up-take and Circular Economy Transition. Available at: https://ec.europa.eu/environment/ecoap/policies-and-practices-eco-innovation-uptake-and-circular-economy-transition_en [Accessed 29th August 2020]
- European Commission – Directorate General Environment. *Circular Economy Indicators*. Available at: https://ec.europa.eu/environment/ecoap/indicators/circular-economy-indicators_en [Accessed 30th May 2020].

- European Commission – Environment. Eco-Innovation Action Plan. *The Eco-Innovation Scoreboard and the Eco-Innovation Index*. Available at: https://ec.europa.eu/environment/ecoap/indicators/index_en [Accessed 25th May 2020].
- European Commission (2015). *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: Closing the loop - An EU action plan for the Circular Economy*. COM (2015) 614 final, Brussels.
- European Commission (2019). *COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS: The European Green Deal*. COM(2019) 640 final, Brussels.
- European Commission (2019). *REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS on the implementation of the Circular Economy Action Plan*. COM(2019) 190 final, Brussels.
- European Commission (2019). *The EU Regional Competitiveness Index 2019*. Regional and Urban Policy. Available at: https://ec.europa.eu/regional_policy/sources/docgener/work/2019_03_rci2019.pdf [Accessed 25th May 2020].
- European Commission (2020). Circular Economy Action Plan: For a cleaner and more competitive Europe. Available at: https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf [Accessed 25th May 2020].
- European Commission (No Date) New Cohesion Policy. Available at: https://ec.europa.eu/regional_policy/en/2021_2027/ [Accessed 25th May 2020].
- Eurostat (2019). Statistics Explained: EU policies for cities and regions. Available at: <https://ec.europa.eu/eurostat/statistics-explained/pdfscache/42679.pdf> [Accessed 25th May 2020].
- Eurostat (2022). *Regional Yearbook*. Luxembourg: Publications Office of the European Union, 2022. Available at: <https://ec.europa.eu/eurostat/documents/3217494/15141223/KS-HA-22%E2%80%911001-EN-N.pdf/f6796190-6856-5f31-68e0-de7dbb9eb337?t=1666181509797> [Accessed 27th October 2022].
- Extremadura 2030: Strategy for green and circular economy (2017). Available at: <https://extremadura2030.com/wp-content/uploads/2018/05/estrategia2030.pdf> [Accessed 27th October 2022]. Flash Eurobarometer 441-TNS Political & Social, (2016) ec.europa.eu/environment/green-growth/.../fl_441_sum_en.pdf (Flash Eurobarometer, 2016).
- Eye@RIS3 Platform. Available at: <https://s3platform.jrc.ec.europa.eu/map>

- Fabregat-Aibar, L.; Barberà-Mariné, M.G.; Terceño, A.; Pié, L. (2019). A Bibliometric and Visualisation Analysis of Socially Responsible Funds. *Sustainability* 11, 2526. <https://doi.org/10.3390/su1109252>.
- Fache', W. (1993). The policy-developing and participative Delphi research method, in: W. Leirman (Ed.), *Delphi- Project 'Education '92': Conclusions and Policy Options*, Katholieke Universiteit, Leuven, 106 – 121.
- Fielden, K. (2003). *Fact or fiction: Qualitative research results in information systems*. Proc of Informing Science InSITE.
- Foschi, E., D'Addato, F., & Bonoli, A. (2021). Plastic waste management: a comprehensive analysis of the current status to set up an after-use plastic strategy in Emilia-Romagna Region (Italy). *Environmental Science and Pollution Research*, 28(19), 24328–24341. <https://doi.org/10.1007/s11356-020-08155-y>
- Frick, S., & Rodríguez-Pose, A. (2018). Big or small cities? On city size and economic growth. *Growth and Change*, 49 (1), 4–32.
- Galician Circular Economy Strategy 2020-2030 (2019). Available at: https://sirga.xunta.gal/c/document_library/get_file?folderId=190428&name=DLFE-55795.pdf
- Gardiner, R., & Hajek, P. (2020). Municipal waste generation, R&D intensity, and economic growth nexus – A case of EU regions. *Waste Management*, 114, 124–135. <https://doi.org/10.1016/j.wasman.2020.06.038>
- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, e. J. (2017). The Circular Economy – A New Sustainability Paradigm? *Journal of Cleaner Production*, 143, 757–768. doi:10.1016/j.jclepro.2016.12.048
- Genovese, Andrea and Pansera, Mario. (2020). The Circular Economy at a Crossroads: Technocratic Eco-Modernism or Convivial Technology for Social Revolution?. *Capitalism Nature Socialism*. 32. 10.1080/10455752.2020.1763414
- Georgescu-Roegen, N. (1993). *The Entropy Law and the Economic Problem*. In *Valuing the Earth: Economics, Ecology, Ethics*, edited by Herman E. Daly, Kenneth Townsend, 75–88. London: MIT Press.
- Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, 114, 11–32. <https://doi.org/10.1016/j.jclepro.2015.09.007>
- Gibbs, D., Deutz, P. (2007). Reflections on implementing Industrial Ecology through eco-industrial park development. *Journal of Cleaner Production*, 15, 1683-1695.
- Gonçalves, A., Galliano, D., & Triboulet, P. (2021). Eco-innovations towards circular economy: evidence from cases studies of collective methanisation in France. *European Planning Studies*, 0(0), 1–21. <https://doi.org/10.1080/09654313.2021.1902947>

- Goyal, S., Chauhan, S., & Mishra, P. (2021). Circular economy research: A bibliometric analysis (2000–2019) and future research insights. *Journal of Cleaner Production*, 287, 125011. <https://doi.org/10.1016/j.jclepro.2020.125011>
- Grant, C., Osanloo, A. (2014). Understanding, Selecting, and Integrating a Theoretical Framework in Dissertation Research: Creating the Blueprint for ‘House’. *Administrative Issues Journal: Connecting Education, Practice and Research*, Pp. 12-22 DOI: 10.5929/2014.4.2.9
- Gravagnuolo, A., Angrisano, M., & Girard, L. F. (2019). Circular economy strategies in eight historic port cities: Criteria and indicators towards a circular city assessment framework. *Sustainability (Switzerland)*, 11(13). <https://doi.org/10.3390/su11133512>
- Gregorio, V. F., Pié, L., & Terceño, A. (2018). A systematic literature review of bio, green and circular economy trends in publications in the field of economics and business management. *Sustainability (Switzerland)*, 10(11). <https://doi.org/10.3390/su10114232>
- Grippo, V., Romano, S., & Vastola, A. (2019). Multi-criteria Evaluation of Bran Use to Promote Circularity in the Cereal Production Chain. *Natural Resources Research*, 28(s1), 125–137. <https://doi.org/10.1007/s11053-019-09457-w>
- Guo, B., Geng, Y., Sterr, T., Zhu, Q., Liu, Y., (2017). Investigating public awareness on circular economy in western China: a case of Urumqi Midong. *J. Clean. Prod.* 142, 2177e2186.
- Harding R., Nauwelaers C., Cohen C., Seigneur I. (2021). Fostering the Green Transition through Smart Specialisation Strategies, EUR 30921 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-45222-5, doi:10.2760/38422, JRC123169
- Hegyi, F. B., Guzzo F., Perianez-Forte I., Gianelle C. (2021). The Smart Specialisation Policy Experience: Perspective of National and Regional Authorities, EUR 30683 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-36370-5, doi:10.2760/554632, JRC123918.
- Henrysson, M., & Nuur, C. (2021). The Role of Institutions in Creating Circular Economy Pathways for Regional Development. *Journal of Environment and Development*, 30(2), 149–171. <https://doi.org/10.1177/1070496521991876>
- Hickel, J., Kallis, G. (2020). Is green growth possible? *New Polit. Econ.* 25 (4), 469– 486. <https://doi.org/10.1080/13563467.2019.1598964> .
- Hirsch, J. E. (2005). An index to quantify an individual’s scientific research output. *Proceedings of the National Academy of Sciences*, 102(46), 16569–16572. <https://doi.org/10.1073/pnas.0507655102>
- Hofstetter, J.S., De Marchi, V., Sarkis, J. et al. (2021). From Sustainable Global Value Chains to Circular Economy—Different Silos, Different Perspectives, but Many Opportunities to Build Bridges. *Circ.Econ.Sust.* 1, 21–47 <https://doi.org/10.1007/s43615-021-00015-2>

- Homrich, A. S., Galvão, G., Abadia, L. G., & Carvalho, M. M. (2018). The circular economy umbrella: Trends and gaps on integrating pathways. *Journal of Cleaner Production*, 175(November), 525–543. <https://doi.org/10.1016/j.jclepro.2017.11.064>
- Husgafvel, R., Linkosalmi, L., & Dahl, O. (2018). Company perspectives on the development of the CE in the seafaring sector and the Kainuu region in Finland. *Journal of Cleaner Production*, 186, 673–681. <https://doi.org/10.1016/j.jclepro.2018.03.138>
- Husgafvel, R., Linkosalmi, L., Hughes, M., Kanerva, J., & Dahl, O. (2018a). Forest sector circular economy development in Finland: A regional study on sustainability driven competitive advantage and an assessment of the potential for cascading recovered solid wood. *Journal of Cleaner Production*, 181, 483–497. <https://doi.org/10.1016/j.jclepro.2017.12.176>
- Iacondini, A., Mencherini, U., Passarini, F., Vassura, I., Fanelli, A., & Cibotti, P. (2015). Feasibility of Industrial Symbiosis in Italy as an Opportunity for Economic Development: Critical Success Factor Analysis, Impact and Constrains of the Specific Italian Regulations. *Waste and Biomass Valorisation*, 6(5), 865–874. <https://doi.org/10.1007/s12649-015-9380-5>
- Iacovidou, E., Velis, C.A., Purnell, P., Zwirnerb, O., Brown, A., Hahladakis, J., Millward-Hopkins, J., William, P. (2017). Metrics for optimising the multi-dimensional value of resources recovered from waste in a circular economy: a critical review. *Journal of Cleaner Production*. 166, 910–938.
- Illich, I. and Lang, A. (1973). *Tools for Conviviality*. Harper & Row.
- Ingstrup, M. B., Aarikka-Stenroos, L., & Adlin, N. (2021). When institutional logics meet: Alignment and misalignment in collaboration between academia and practitioners. *Industrial Marketing Management*, 92(December 2019), 267–276. <https://doi.org/10.1016/j.indmarman.2020.01.004>
- Johansson, A., Kisch, P. and Mirata, M. (2005). Distributed Economies—A New Engine for Innovation. *Journal of Cleaner Production*. 13 (10–11), 971–979. doi:10.1016/j.jclepro.2004.12.015.
- Kanchanapibul, M., Lacka, E., Wang, X., Chan, H.K., (2014). An empirical investigation of green purchase behaviour among the young generation. *J. Clean. Prod.* 66, 528–536.
- Kaya, D. I., Pintossi, N., & Dane, G. (2021). An empirical analysis of driving factors and policy enablers of heritage adaptive reuse within the circular economy framework. *Sustainability (Switzerland)*, 13(5), 1–25. <https://doi.org/10.3390/su13052479>
- Khirfan, L., Peck, M., & Mohtat, N. (2020). Systematic content analysis: A combined method to analyse the literature on the daylighting (de-culverting) of urban streams. *MethodsX*, 7, 100984. <https://doi.org/10.1016/j.mex.2020.100984>

- King, N. and Brookes, J. M. (2017). *Template Analysis for Business and Management Students*. London: Sage.
- Kirchherr, J., Piscicelli, L., Bour, R., Huibrechtse-truijens, A., Hekkert, M., Kostense- smit, E., Muller, J. (2018). Barriers to the circular Economy: evidence from the European union (EU). *Ecological Economics*. 150, 264-272. <https://doi.org/10.1016/j.ecolecon.2018.04.028>
- Kirchherr, J., Reike, D., Hekkert, M., (2017). Conceptualising the circular economy: an analysis of 114 definitions. *Resour. Conserv. Recy.* 127, 221–232. <https://doi.org/10.1016/j.resconrec.2017.09.005>.
- Kivunja, C. (2018). Distinguishing between Theory, Theoretical Framework, and Conceptual Framework: A Systematic Review of Lessons from the Field. *International Journal of Higher Education*. 7. 44. 10.5430/ijhe.v7n6p44
- Kivunja, C. and Kuyini, A. B. (2017). Understanding and Applying Research Paradigms in Educational Contexts. *International Journal of Higher Education*, 6(5), 26-41 <https://doi.org/10.5430/ijhe.v6n5p26>
- Kohr, L. (1957). *The Breakdown of Nations*. London: Routledge & Kegan Paul.
- Kokkinos, K., Karayannis, V., & Moustakas, K. (2020). Circular bio-economy via energy transition supported by Fuzzy Cognitive Map modeling towards sustainable low-carbon environment. *Science of the Total Environment*, 721, 137754. <https://doi.org/10.1016/j.scitotenv.2020.137754>
- Kommunal- og moderniseringsdepartementet. (2020). Forholdet kommune-stat. Retrieved from: <https://www.regjeringen.no/no/tema/kommuner- og- regioner/ kommunalrett- og- kommunal- inndeling/forholdet- kommune- stat/id2340288/>
- Korhonen, J., Nuur, C., Feldmann, A., & Birkie, S. E. (2018). Circular economy as an essentially contested concept. *Journal of Cleaner Production*, 175, 544–552. <https://doi.org/https://doi.org/10.1016/j.jclepro.2017.12.111>
- Kumar, R. (2014). *Research Methodology: A Step-by-Step Guide for Beginners*, Fourth ed.
- Lakatos, E.S., Dan, V., Cioca, L.I., Bacali, L., Ciobanu, A.M., (2016). How supportive are Romanian consumers of the circular economy concept: a survey. *Sustainability* 8 (8), 789.
- Larosse, J., Corpakis, D., Truffs, R. (2020). The Green Deal and Smart Specialisation. Version 4. Friends of Smart Specialisation. Available online: <https://www.efiscentre.eu/wp-content/uploads/2020/03/The-Green-Deal-and-Smart-Specialisation-draft-2- v4-final.pdf> [Accessed 15th January 2021].
- Lechner, G., Wagner, M. J., Diaz Tena, A., Fleck, C., & Reimann, M. (2021). Exploring a regional repair network with a public funding scheme for customer repairs: The ‘GRAZ repariert’-case. *Journal of Cleaner Production*, 288, 125588. <https://doi.org/10.1016/j.jclepro.2020.125588>

- Lidström, A. (2018). Subnational Sweden, the national state and the EU. *Region. Federal Stud.* 30 (2), 137–154. <https://doi.org/10.1080/13597566.2018.1500907>.
- Liu, J., Feng, Y., Zhu, Q., & Sarkis, J. (2018). Green supply chain management and the circular economy: Reviewing theory for advancement of both fields. *International Journal of Physical Distribution and Logistics Management*, 48(8), 794–817. <https://doi.org/10.1108/IJPDLM-01-2017-0049>
- Liu, Q., Li, H.-m., Zuo, X.-l., Zhang, F.-f., Wang, L., (2009), A survey and analysis on public awareness and performance for promoting circular economy in China: a case study from Tianjin. *J. Clean. Prod.* 17, 265e270.
- Liu, Y., Bai, Yi, (2014). An exploration of firms' awareness and behaviour of developing circular economy: an empirical research in China. *Resources. Conserv. Recycl.* 87, 145-152.
- Llorente-Gonzalez, L. J., and Vence, X. (2019). Decoupling or 'Decaffing'? The Underlying Conceptualisation of Circular Economy in the European Union Monitoring Framework. *Sustainability*. 11(18), 4898.
- Lombardi, R. (2017). Non-technical barriers to (And drivers for) the circular economy through industrial symbiosis: A practical input. *Economics and Policy of Energy and the Environment*, 2017(1), 171–189. <https://doi.org/10.3280/EFE2017-001009>
- Madden, B., Florin, N., Mohr, S., & Giurco, D. (2019). Using the waste Kuznet's curve to explore regional variation in the decoupling of waste generation and socioeconomic indicators. *Resources, Conservation and Recycling*, 149, 674–686. <https://doi.org/10.1016/j.resconrec.2019.06.025>
- Mahanty, S., Boons, F., Handl, J. and Batista-Navarro, R. (2021). An investigation of academic perspectives on the 'circular economy' using text mining and a Delphi study. *Journal of Cleaner Production*. 319. 128574. 10.1016/j.jclepro.2021.128574.
- Manzini, E. (2013). Resilient Systems and Cosmopolitan Localism — the Emerging Scenario of the Small, Local, Open and Connected Space. *Economy of Sufficiency*. Wuppertal Special 48. 70.
- Marra, A., Mazzocchitti, M., & Sarra, A. (2018). Knowledge sharing and scientific cooperation in the design of research-based policies: The case of the circular economy. *Journal of Cleaner Production*, 194, 800–812. <https://doi.org/10.1016/j.jclepro.2018.05.164>
- Matsunaga, K. and N. Themelis (2002). Effects of affluence and population density on waste generation and disposal of municipal solid wastes. Available at: https://www.researchgate.net/publication/228908198_Effects_of_affluence_and_population_density_on_waste_generation_and_disposal_of_municipal_solid_wastes
- Maucorps, A., Römisch, R., Schwab, T., Vujanovic, N. (2022). *The Future of EU Cohesion: Effects of the Twin Transition on Disparities across European Regions*. Bertelsmann Stiftung, October 2022. <https://doi.org/10.11586/2022127>

- McCann, P., Soete, L., (2020). *Place-based Innovation for Sustainability*. Publications Office of the European Union, Luxembourg. <https://doi.org/10.2760/250023>, 2020, ISBN 978-92-76-20392-6JRC121271.
- McDowall, W., Geng, Y., Huang, B., Bartekova, E., Bleischwitz, R., Türkeli, S., Kemp, R., Domenech, T., (2017). Circular economy policies in China and Europe. *Journal of Industrial Ecology*, 21, 651-661. <https://doi.org/10.1111/jiec.12597>.
- McKenna, L. and Gray, R. (2018). The importance of ethics in research publications. *Collegian*, 25(2), 147-148 <https://doi.org/10.1016/j.colegn.2018.02.006>
- McKinsey Global Institute (2012). *Urban world: Cities and the rise of the consuming class*, Available at: <http://www.mckinsey.com/mgi>.
- Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production*, 178, 703–722. <https://doi.org/10.1016/j.jclepro.2017.12.112>
- Miedzinski, M., Ciampi Stancova, K., Matusiak, M., Coenen, L. (2021). *Addressing Sustainability Challenges and Sustainable Development Goals via Smart Specialisation. Towards a Theoretical and Conceptual Framework.*, EUR 30864 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-42380-5, doi:10.2760/410983, JRC126448
- Mihai, F. C., & Grozavu, A. (2019). Role of waste collection efficiency in providing a cleaner rural environment. *Sustainability (Switzerland)*, 11(23). <https://doi.org/10.3390/su11236855>
- Mirata, M. (2004). Experiences from early stages of a national industrial symbiosis programme in the UK: Determinants and coordination challenges. *Journal of Cleaner Production*, 12(8–10), 967–983. <https://doi.org/10.1016/j.jclepro.2004.02.031>
- Mirata, M., & Emtairah, T. (2005). Industrial symbiosis networks and the contribution to environmental innovation: The case of the Landskrona industrial symbiosis programme. *Journal of Cleaner Production*, 13(10–11), 993–1002. <https://doi.org/10.1016/j.jclepro.2004.12.010>
- Mongeon, P.; Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis, *Scientometrics*, 106 (1), 213-228.
- Monitor Circular Economy Flanders. Available at: <https://cemonitor.be/over/over-deze-monitor/>
- Montevecchi, F. and H. Reisinger (2014). *File note on circular economy package for the Territorial Impact Assessment workshop*, <http://dx.doi.org/10.2863/11040>.
- Moraga, G., Huysveld, S., Mathieux, F., Blengini, G. A., Alaerts, L., Van Acker, K., de Meester, S., Dewulf, J. (2019). Circular economy indicators: What do they measure? *Resources, Conservation and Recycling*, 146, 452–461.

- Morikawa, M. (2012). Population density and efficiency in energy consumption: An empirical analysis of service establishments, *Energy Economics*, 34(5), 1617-1622, <http://dx.doi.org/10.1016/j.eneco.2012.01.004>.
- Mugion, R. G., Arcese, G., Toni, M., & Silvestri, L. (2019). *Life Cycle Management and Sharing Economy*. 152–166. <https://doi.org/10.4018/978-1-7998-1419-1.ch008>
- Murray, A., Skene, K., Haynes, K., (2017). The circular economy: an interdisciplinary exploration of the concept and application in a global context. *Journal of Business Ethics*. 140, 369-380. <https://doi.org/10.1007/s10551-015-2693-2>
- Myers, M. D. (2013). *Qualitative research in business and management*. Sage.
- Nohra, C. G., Pereno, A., & Barbero, S. (2020). Systemic design for policy-making: Towards the next circular regions. *Sustainability (Switzerland)*, 12(11). <https://doi.org/10.3390/su12114494>
- Nordregio Policy Brief (2019). *Implementing Smart Specialisation strategies in Nordic regions*. Available at: <https://norden.diva-portal.org/smash/get/diva2:1334482/FULLTEXT01.pdf> [Accessed 30th October 2022].
- Obersteg, A., Arlati, A., Acke, A., Berruti, G., Czapiewski, K., Dąbrowski, M., ... Knieling, J. (2019). Urban Regions Shifting to Circular Economy: Understanding Challenges for New Ways of Governance. *Urban Planning*, 4(3), 19. <https://doi.org/10.17645/up.v4i3.2158>
- OECD (2017). THE MACROECONOMICS OF THE CIRCULAR ECONOMY TRANSITION: A CRITICAL REVIEW OF MODELLING APPROACHES. ENV/EPOC/WPRPW/WPIEEP(2017)1/FINAL
- OECD (2019). *The Circular Economy in Cities and Regions: Brochure*. Available at: <http://www.oecd.org/cfe/regional-policy/Circular-economy-brochure.pdf> [Accessed 25th May 2020].
- OECD (2019). Financing climate objectives in cities and regions to deliver sustainable and inclusive growth, *OECD Environment Policy Papers*, No. 17, OECD Publishing, Paris, <https://doi.org/10.1787/ee3ce00b-en>
- OECD (2020). *The Circular Economy in Umeå, Sweden*, OECD Urban Studies, OECD Publishing, Paris, Available at: <https://www.oecd-ilibrary.org/sites/4ec5dbcd-en/index.html?itemId=/content/publication/4ec5dbcd-en> [Accessed 25th May 2020].
- OECD (2020). *The Circular Economy in Cities and Regions: Synthesis Report*, OECD Urban Studies, OECD Publishing, Paris, <https://doi.org/10.1787/10ac6ae4-en>
- OECD (No Date) *The Circular Economy in Cities and Regions*. Available at: <https://www.oecd.org/cfe/regional-policy/circular-economy-cities.htm> [Accessed 22nd May 2020].

- OECD Regional Well-Being. Available at: <https://www.oecdregionalwellbeing.org/>
- OECD Survey (2020). *OECD Survey on Circular Economy in Cities and Regions*, OECD, Paris
- OECD/EC (2020). *Cities in the World: A New Perspective on Urbanisation*, OECD Urban Studies, OECD Publishing, Paris, <https://dx.doi.org/10.1787/d0efcbda-en>.
- OECDa (2020). *OECD Economic Outlook, Volume 2020 Issue 1*, OECD Publishing, Paris, <https://dx.doi.org/10.1787/0d1d1e2e-en>.
- Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: An example, design considerations and applications. *Information and Management*, 42(1), 15–29. <https://doi.org/10.1016/j.im.2003.11.002>
- Ortega Alvarado, I. A., Sutcliffe, T. E., Berker, T., & Pettersen, I. N. (2021). Emerging circular economies: Discourse coalitions in a Norwegian case. *Sustainable Production and Consumption*, 26, 360–372. <https://doi.org/10.1016/j.spc.2020.10.011>
- Paletta, A., Leal Filho, W., Balogun, A. L., Foschi, E., & Bonoli, A. (2019). Barriers and challenges to plastics valorisation in the context of a circular economy: Case studies from Italy. *Journal of Cleaner Production*, 241, 118149. <https://doi.org/10.1016/j.jclepro.2019.118149>
- Parrique T., Barth J., Briens F., C. Kerschner, Kraus-Polk A., Kuokkanen A., Spangenberg J.H., (2019). *Decoupling debunked: Evidence and arguments against green growth as a sole strategy for sustainability*. European Environmental Bureau. Available at: <https://mk0eeborgicuyptuf7e.kinstacdn.com/wp-content/uploads/2019/07/Decoupling-Debunked.pdf>
- Patricio, J., Axelsson, L., Blomé, S., & Rosado, L. (2018). Enabling industrial symbiosis collaborations between SMEs from a regional perspective. *Journal of Cleaner Production*, 202, 1120–1130. <https://doi.org/10.1016/j.jclepro.2018.07.230>
- Patricio, J., Kalmykova, Y., & Rosado, L. (2020). A method and databases for estimating detailed industrial waste generation at different scales – With application to biogas industry development. *Journal of Cleaner Production*, 246, 118959. <https://doi.org/10.1016/j.jclepro.2019.118959>
- Pauliuk, S. (2018). Critical appraisal of the circular economy standard BS 8001: 2017 and a dashboard of quantitative system indicators for its implementation in organisations. *Resources, Conservation and Recycling*, 129, 81–92.
- Pearce, David W., and R. Kerry Turner (1990). *Economics of Natural Resources and the Environment*, Vol. 73. Baltimore, MD: The Johns Hopkins University Press. <https://doi:10.2307/1242904>
- Pickvance, C. G. (2000). Local-Level Influences on Environmental Policy Implementation in Eastern Europe: A Theoretical Framework and a Hungarian Case Study.' *Environment and Planning C: Government and Policy* 18 (4), 469–485. <https://doi:10.1068/c9811j>

- POLITICO (2018). *Ranking how EU countries do with the circular economy*. Available at: <https://www.politico.eu/article/ranking-how-eu-countries-do-with-the-circular-economy/> [Accessed 30th May 2020].
- Pontikakis, D., Fernández Sirera, T., Janssen, M., Guy, K., Marques Santos, A., Boden, J.M. and Moncada-Paternò-Castello, P., (2020). *Projecting Opportunities for INdustrial Transitions (POINT): Concepts, rationales and methodological guidelines for territorial reviews of industrial transition*, EUR 30375 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-22152-4, doi:10.2760/590389, JRC121439.
- Pontikakis, D., González Vázquez, I., Bianchi, G., Ranga, M., Marques Santos, A., Reimeris, R., Mifsud, S., Morgan, K., Madrid, C., Stierna, J., (2022). *Partnerships for Regional Innovation – Playbook - Concepts and Rationales*, EUR 31064 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-52359-8, doi:10.2760/415348, JRC129327.
- Poponi, S., Arcese, G., Mosconi, E. M., & di Trifiletti, M. (2020). Entrepreneurial Drivers for the Development of the Circular Business Model: The Role of Academic Spin-Off. *Sustainability*, 12(1). <https://doi.org/10.3390/su12010423>
- Prendeville, S., Cherim, E., Bocken, N. (2016). *Circular cities: mapping six cities in transition. Environmental Innovation and Societal Transition*. <https://doi.org/10.1016/j.eist.2017.03.002>.
- Prieto-Sandoval, V., Jaca, C., & Ormazabal, M. (2018). Towards a consensus on the circular economy. *Journal of Cleaner Production*, 179, 605–615. <https://doi.org/10.1016/j.jclepro.2017.12.224>
- Ranta, V., Aarikka-Stenroos, L., Ritala, P., & Mäkinen, S. J. (2018). Exploring institutional drivers and barriers of the circular economy: A cross-regional comparison of China, the US, and Europe. *Resources, Conservation and Recycling*, 135, 70–82. <https://doi.org/10.1016/j.resconrec.2017.08.017>
- Ratan, S., Anand, T. and Ratan, J. (2019). *Formulation of Research Question – Stepwise Approach*. *Journal of Indian Association of Pediatric Surgeons*. 24 (15). 10.4103/jiaps.JIAPS_76_18.
- Real, M., Lizarralde, I., & Tyl, B. (2020). Exploring Local Business Model Development for Regional Circular Textile Transition in France. *Fashion Practice*, 12(1), 6–33. <https://doi.org/10.1080/17569370.2020.1716546>
- Region Central Jutland's Development Strategy 2019-2030 (2019). Available at: <https://www.rm.dk/regional-udvikling/strategi/> [Accessed 1st November 2022].
- Regional Action Plan for the Circular Economy 2018-2025 (2019). Available at: <https://www.paysdelaloire.fr/transition-ecologique/economie-circulaire>
- Regional Innovation Plan 2021–2027 (2021). Available at: <https://innoviris.brussels/regional-innovation-plan> [Accessed 1st November 2022].

- Regional plan of the circular economy and remediation (Upcoming, 2022). Available at: <https://www.regione.toscana.it/-/informazione-e-partecipazione-piano-economia-circolare-e-bonifiche>
- Research and Innovation Smart Specialisation Strategy (2017). Available at: <https://meco.gouvernement.lu/dam-assets/publications/rapport-etude-analyse/minist-economie/ris3/luxembourg-research-and-innovation-smart-specialisation-strategy-2017.pdf> [Accessed 1st November 2022].
- Research and Innovation Strategy for Smart Specialisation 2014-2020 (2015). Available at: <https://www.ris3rcm.eu/en/about/ris3/>. [Accessed 1st November 2022].
- Research and Innovation Strategy for the Smart Specialisation of Catalonia RIS3CAT 2014-2020 (2014). Available at: http://catalunya2020.gencat.cat/web/.content/00_catalunya2020/Documents/angles/fitxers/07_ris3cat_2014_en.pdf [Accessed 1st November 2022].
- Rialti, R., Marzi, G., Ciappei, C., & Busso, D. (2019). Big data and dynamic capabilities: a bibliometric analysis and systematic literature review. *Management Decision*, 57(8), 2052–2068. <https://doi.org/10.1108/MD-07-2018-0821>
- RIS3 Extremadura 2027 (2021). Available at: https://www.ris3extremadura.es/wp-content/uploads/2022/04/Summary_RIS3.pdf [Accessed 1st November 2022].
- RIS3 Northern Netherlands 2021-2027 (2021). Available at: <https://s3platform.jrc.ec.europa.eu/s3-for-sdgs-in-the-northern-netherlands> [Accessed 1st November 2022].
- Ritzen, S. and Sandstrom, G.O. (2017). Barriers to the Circular Economy — Integration of perspectives and domains. *Procedia CIRP*, 64, 7–12.
- S3 Platform. Available at: <https://s3platform.jrc.ec.europa.eu/edp> [Accessed 27th January 2022].
- Sackman, H. (1975). *Delphi-critique: Expert Opinion, Forecasting and Group Process*, Lexington Books, Massachusetts.
- Saidani, M., Yannou, B., Leroy, Y., Cluzel, F., Kendall, A. (2019). A taxonomy of circular economy indicators. *Journal of Cleaner Production*, 207, 542–559.
- Sánchez Levoso, A., Gasol, C. M., Martínez-Blanco, J., Durany, X. G., Lehmann, M., & Gaya, R. F. (2020). Methodological framework for the implementation of circular economy in urban systems. *Journal of Cleaner Production*, 248. <https://doi.org/10.1016/j.jclepro.2019.119227>
- Sani, D., Picone, S., Bianchini, A., Fava, F., Guarnieri, P., & Rossi, J. (2021). An overview of the transition to a circular economy in emilia-romagna region, Italy considering technological, legal-regulatory and financial points of view: A case study. *Sustainability (Switzerland)*, 13(2), 1–23. <https://doi.org/10.3390/su13020596>

- Santagata, R., Zucaro, A., Viglia, S., Ripa, M., Tian, X., & Ulgiati, S. (2020). Assessing the sustainability of urban eco-systems through Emergy-based circular economy indicators. *Ecological Indicators*, 109, 105859. <https://doi.org/10.1016/j.ecolind.2019.105859>
- Sastre, S., Llopart, J., & Puig Ventosa, I. (2018). Mind the gap: A model for the EU recycling target applied to the Spanish regions. *Waste Management*, 79, 415–427. <https://doi.org/10.1016/j.wasman.2018.07.046>
- Sauders, M., Lewis, P. and Thornhill, A. (2003). *Research methods for business students*. New Jersey 4, 100-109.
- Saunders, M. N. K., Thornhill, A., & Lewis, P. (2019). *Research methods for business students*.
- Savini, F. (2019). The economy that runs on waste: accumulation in the circular city. *Journal of Environmental Policy and Planning*, 21(6), 675–691. <https://doi.org/10.1080/1523908X.2019.1670048>
- Savini, F., & Giezen, M. (2020). Responsibility as a field: The circular economy of water, waste, and energy. *Environment and Planning C: Politics and Space*, 38(5), 866–884. <https://doi.org/10.1177/2399654420907622>
- Scarpellini, S., Portillo-Tarragona, P., Aranda-Usón, A., & Llena-Macarulla, F. (2019). Definition and measurement of the circular economy's regional impact. *Journal of Environmental Planning and Management*, 62(13), 2211–2237. <https://doi.org/10.1080/09640568.2018.1537974>
- Scott, W.R. (1987). The Adolescence of Institutional Theory. *Adm. Sci. Q.* 32, 493–511. doi:10.2307/2392880
- Scott, W.R. (2003). Institutional carriers: reviewing modes of transporting ideas over time and space and considering their consequences. *Ind. Corp. Chang.* 12, 879–894.
- Scott, W.R. (2008). *Institutions and Organisations: Ideas and interests*, 3rd Editio. ed. Sage Publications, Thousand Oaks, California.
- Shannon-Baker, P (2015). Making Paradigms Meaningful in Mixed Methods Research. *Journal of Mixed Methods Research*, 10(4), 319-334 <https://doi.org/10.1177/1558689815575861>
- Sharma, Y.K., Mangla, S.K., Patil, P.P., and Liu, S. (2019). When challenges impede the process. *Management Decision*. 57(4), 995-1017.
- Silvestri, F., Spigarelli, F., & Tassinari, M. (2020). Regional development of Circular Economy in the European Union: A multidimensional analysis. *Journal of Cleaner Production*, 255, 120218. <https://doi.org/10.1016/j.jclepro.2020.120218>
- Sjöblom, S. (2018). Finnish regional governance structures in flux: reform processes between European and domestic influences. *Region. Federal Stud.* 30(2), 155– 174. <https://doi.org/10.1080/13597566.2018.1541891>.

- Skene, K.R. (2018). Circles, spirals, pyramids and cubes: Why the circular economy cannot work. *Sustain. Sci*, 13, 479–492.
- Smart Specialisation Strategy of Galicia 2014-2020 (2014). Available at: http://www.onlines3.eu/wp-content/uploads/RIS3_strategy_repository/ES_Galicia_RIS3_Strategy.pdf [Accessed 1st November 2022].
- Smol, M., Avdiushchenko, A., Kulczycka, J., & Nowaczek, A. (2018). Public awareness of circular economy in southern Poland: Case of the Malopolska region. *Journal of Cleaner Production*, 197, 1035–1045. <https://doi.org/10.1016/j.jclepro.2018.06.100>
- Smol, M., Kulczycka, J., Avdiushchenko, A. (2017). Circular economy indicators in relation to eco-innovation in European regions. *Clean Technology, Environment and Policy*. 19 (3), 669–678.
- Song, B., Yeo, Z., Kohls, P., Herrmann, C. (2017). Industrial symbiosis: exploring big- data approach for waste stream discovery. *Procedia CIRP* 61, 353-358.
- Stanojev, J., & Gustafsson, C. (2021). Smart specialisation strategies for elevating integration of cultural heritage into circular economy. *Sustainability (Switzerland)*, 13(7). <https://doi.org/10.3390/su13073685>
- Strat, V.A., Teodor, C., and Săseanu, A.S. (2018). The characterisation of the Romanian circular economy's potential, at county level. *Amfiteatru Economic*, 20 (48), 278–293. <https://doi.org/10.24818/EA/2018/48/278>.
- Strategy Circular South Holland: Accelerate Together (2019). Available at: <https://circulair.zuid-holland.nl/>
- Strategy to promote the green economy and the circular economy (2015). Available at: https://mediambient.gencat.cat/es/05_ambits_dactuacio/empresa_i_produccio_sostenible/economia_verda/impuls_economia_verda/index.html
- SUMMA CE Centre (2018). *SHORT-TERM ASSIGNMENT - Indicators for a Circular Economy. Circular Flanders*. Available at: <https://vlaanderen-circulair.be/en/summa-ce-centre/publications/indicators-for-a-circular-economy> [Accessed 30th May 2020].
- Sustainability Strategy 2030 for Central Denmark Region (2021). Available at: https://www.rm.dk/siteassets/om-os/english/sustainability-strategy/rm---strategi-for-baredygtighed_uk_enkelt_tilgangelig.pdf
- Sutcliffe, T. E., & Ortega Alvarado, I. A. (2021). Domesticating circular economy? An enquiry into Norwegian subnational authorities' process of implementing circularity. *Journal of Environmental Policy and Planning*, 1–14. <https://doi.org/10.1080/1523908X.2021.1910016>
- Tabari, Saloomah, King, Nigel and Egan, David (2020). Potential application of template analysis in qualitative hospitality management research. *Hospitality & Society*, 10(2), 197–216, doi: https://doi.org/10.1386/hosp_00020_1

- Taddeo, R. (2016). Local industrial systems towards the eco-industrial parks: The model of the ecologically equipped industrial areas. *Journal of Cleaner Production*, 131, 189–197. <https://doi.org/10.1016/j.jclepro.2016.05.051>
- Taddeo, R., Simboli, A., Ioppolo, G., & Morgante, A. (2017). Industrial symbiosis, networking and innovation: The potential role of innovation poles. *Sustainability (Switzerland)*, 9(2), 1–17. <https://doi.org/10.3390/su9020169>
- Tazi, N., Idir, R., & Ben Fraj, A. (2021). Towards achieving circularity in residential building materials: Potential stock, locks and opportunities. *Journal of Cleaner Production*, 281, 124489. <https://doi.org/10.1016/j.jclepro.2020.124489>
- Tessitore, S., Daddi, T., & Iraldo, F. (2015). Eco-industrial parks development and integrated management challenges: Findings from Italy. *Sustainability (Switzerland)*, 7(8), 10036–10051. <https://doi.org/10.3390/su70810036>
- Think 2030 (2018). *A long-term strategy for a European circular economy – setting the course for success*. Policy paper produced for the Think2030 project, Brussels, November 2018.
- Towa, E., Zeller, V., & Achten, W. M. J. (2021). Circular economy scenario modelling using a multiregional hybrid input-output model: The case of Belgium and its regions. *Sustainable Production and Consumption*, 27, 889–904. <https://doi.org/10.1016/j.spc.2021.02.012>
- Towa, E., Zeller, V., & Achten, W. M. J. (2021a). Assessing the circularity of regions: Stakes of trade of waste for treatment. *Journal of Industrial Ecology*, 1–14. <https://doi.org/10.1111/jiec.13106>
- Towa, E., Zeller, V., Merciai, S., & Achten, W. M. J. (2021b). Regional waste footprint and waste treatments analysis. *Waste Management*, 124, 172–184. <https://doi.org/10.1016/j.wasman.2021.02.011>
- Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management*, 14(3), 207–222. <https://doi.org/10.1111/1467-8551.00375>
- Trauth, E. M. (2001). *The choice of qualitative methods in IS research. Qualitative Research in IS: Issues and Trends*.
- Trochim, W. M. and Donnelly, J. P. (2001). *Research methods knowledge base*.
- Tura, N.; Hanski, J.; Ahola, T.; Ståhle, M.; Piiparinen, S.; Valkokari, P. (2019). Unlocking circular business: A framework of barriers and drivers. *Journal of Cleaner Production*. 212, 90–98.
- Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B. and van Vuuren, D. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change*, 35, 239–253. doi:10.1016/j.gloenvcha.2015.08.010

- UNEP (2018). *The Weight of Cities*, International Resource Panel, United Nations Environment Programme.
- UNEP (2019). *Emissions Gap Report 2019*, United Nations Environment Programme, Available at: <http://www.un.org/Depts/Cartographic/english/htmain.htm>
- Valenzuela, F. and Böhm, S. (2017). Against wasted politics : A critique of the circular economy. *Ephemera* 17, 23–60.
- Van den Berghe, K., & Vos, M. (2019). Circular Area Design or Circular Area Functioning? A Discourse-Institutional Analysis of Circular Area Developments in Amsterdam and Utrecht, The Netherlands. *Sustainability*, 11(18), 4875. <https://doi.org/10.3390/su11184875>
- van Zolingen, S. J., & Klaassen, C. A. (2003). Selection processes in a Delphi study about key qualifications in Senior Secondary Vocational Education. *Technological Forecasting and Social Change*, 70(4), 317–340. [https://doi.org/https://doi.org/10.1016/S0040-1625\(02\)00202-0](https://doi.org/10.1016/S0040-1625(02)00202-0)
- Vanhamaki, S., Medkova, K., Malamakis, A., Kontogianni, S., Marisova, E., Dellago, D. H., & Moussiopoulos, N. (2019). Bio-based circular economy in European national and regional strategies. *International Journal of Sustainable Development and Planning*, 14(1), 31–43. <https://doi.org/10.2495/SDP-V14-N1-31-43>
- Vanhamäki, S., Rinkinen, S., & Manskinen, K. (2021). Adapting a circular economy in regional strategies of the European Union. *Sustainability (Switzerland)*, 13(3), 1–15. <https://doi.org/10.3390/su13031518>
- Vanhamäki, S., Virtanen, M., Luste, S., & Manskinen, K. (2020). Transition towards a circular economy at a regional level: A case study on closing biological loops. *Resources, Conservation and Recycling*, 156(January), 104716. <https://doi.org/10.1016/j.resconrec.2020.104716>
- Vieira, E. S.; Gomes, J. A. N. F. (2009). A comparison of Scopus and Web of Science for a typical university. *Scientometrics*, 81 (2), pp. 587-600.
- Virtanen, M., Manskinen, K., Uusitalo, V., Syväne, J., & Cura, K. (2019). Regional material flow tools to promote circular economy. *Journal of Cleaner Production*, 235, 1020–1025. <https://doi.org/10.1016/j.jclepro.2019.06.326>
- Vision 2050: A Long-Term Strategy for Flanders (2016). Available at: <https://publicaties.vlaanderen.be/view-file/28831>
- Volk, R., Müller, R., Reinhardt, J., & Schultmann, F. (2019). An Integrated Material Flows, Stakeholders and Policies Approach to Identify and Exploit Regional Resource Potentials. *Ecological Economics*, 161(April), 292–320. <https://doi.org/10.1016/j.ecolecon.2019.03.020>

- Wachsmuth, D. (2012). Three Ecologies: Urban Metabolism and the Society-Nature Opposition. *Soc. Q.*, 53, 506-523.
- Wahyuni, D (2012). The Research Design Maze: Understanding Paradigms, Cases, Methods and Methodologies. *Journal of Applied Management Accounting Research*, 10(1) pp. 69-80
<http://hdl.handle.net/10536/DRO/DU:30057483>
- WBCSD (No Date). *Circular Transition Indicators V1.0 – Metrics for business, by business*. Available at: <https://www.wbcsd.org/Programs/Circular-Economy/Factor-10/Metrics-Measurement/Resources/Circular-Transition-Indicators-V1.0-Metrics-for-business-by-business> [Accessed 22nd May 2020].
- Wendling, Z. A., Emerson, J. W., de Sherbinin, A., Esty, D. C. (2018). *2018 Environmental Performance Index*. New Haven, CT: Yale Centre for Environmental Law & Policy. <https://epi.yale.edu/>
- Whicher, A., Harris, C., Beverley, K., & Swiatek, P. (2018). Design for circular economy: Developing an action plan for Scotland. *Journal of Cleaner Production*, 172, 3237–3248.
<https://doi.org/10.1016/j.jclepro.2017.11.009>
- Widmer, T., & Prior, D. (2019). Institutional Isomorphism, Institutional Logics and Organisational Fields: An Institutional Perspective on Circular Economy. *Proceedings of the Spring Servitisation Conference 2019*, (May).
- Wijkman, A. and K. Skånberg (2017). *The Circular Economy and Benefits for Society: Jobs and Climate Clear Winners in an Economy Based on Renewable Energy and Resource Efficiency*, The Club of Rome.
- Winans, K., Kendall, A., Deng, H. (2017). The history and current applications of the circular economy concept. *Renew. Sustain. Energy Rev.* 68(1), 825-833. <https://doi.org/10.1016/j.rser.2016.09.123>
- World Commission of Environment and Development (1987). *Report of the World Commission of Environment and Development: Our Common Future*.
- Woudenberg, F. (1991). An evaluation of Delphi, *Technol. Forecast. Soc. Change* 40 (2) 131–150.
- Xue, B., Chen, X-p., Geng, Y., Guo, X-j., Lu, Ch-p., Zhang, Z-l., Luc, Ch-y (2010). Survey of officials' awareness on circular economy development in China: based on municipal and county level. *Resour. Conserv. Recycl.* 54, 1296-1302.
- Yilmaz Kaplan (2022). How to achieve an institutional change towards circular economy? A comparative case study on the EU and China, *Globalisations*, DOI: [10.1080/14747731.2022.2068235](https://doi.org/10.1080/14747731.2022.2068235)
- Yu, Y., Yazan, D. M., Bhochhibhoya, S., & Volker, L. (2021). Towards Circular Economy through Industrial Symbiosis in the Dutch construction industry: A case of recycled

- concrete aggregates. *Journal of Cleaner Production*, 293, 126083.
<https://doi.org/10.1016/j.jclepro.2021.126083>
- Zeng, H., Chen, X., Xiao, X., Zhou, Z. (2017). Institutional pressures, sustainable supply chain management, and circular economy capability: empirical evidence from Chinese eco-industrial park firms. *J. Clean. Prod.* 155, 54-65.
- Zhu, J., & Ruth, M. (2014). The development of regional collaboration for resource efficiency: A network perspective on industrial symbiosis. *Computers, Environment and Urban Systems*, 44, 37–46. <https://doi.org/10.1016/j.compenvurbsys.2013.11.001>
- Zink, T., F. Maker, R. Geyer, R. Amirtharajah, and V. Akella (2014). Comparative life cycle assessment of smartphone reuse: Repurposing vs. refurbishment. *The International Journal of Life Cycle Assessment*, 19(5), 1099–1109.
- Zink, Trevor and Geyer, Roland (2017). Circular Economy Rebound. *Journal of Industrial Ecology*, 21. 10.1111/jiec.12545.