INDICATORS AND METHODS FOR MEASURING TRANSITION TO CLIMATE NEUTRAL CIRCULARITY

Task 5: Case-study group 1

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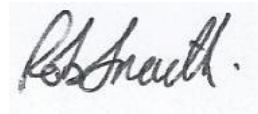
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1. INTRODUCTION

The transition to a circular economy (CE) needs to occur on multiple levels, from households and individual consumers to national and cross-border ecosystems. Measuring and monitoring the development of this transition is an ambitious task and is ideally supported by indicators relevant to all steps in that process.

This case-study is one of 19 developed for a research project into "*Indicators and methods for measuring transition to climate neutral circularity, its benefits, challenges and trade-offs*". It provides a detailed summary of the development and testing programme conducted for Group 1 of the Cities and Regions sub-policy area during Task 5 of the project. The main purpose of this case-study is:

1. Provide an overview of the testing and monitoring method adopted for each indicator.
2. Outline the key results and performance of each indicator.
3. Highlight any challenges or lessons learnt from the identification, planning, delivery and analysis of the relevant methodology for each indicator.

The aim of Task 5 is to take the learnings of all other Tasks thus far and develop and test the new indicators identified in Tasks 3 and 4 as having potential to enable a deeper understanding of the 3 facets of circularity for the five key approaches. This case-study is a direct output of Task 5.

This case-study focuses on the following 3 indicators outlined in Table 1.

Table 1. Overview of case-study group CR1

URN		Indicator name	Methodology	Level of implementation				
				EU	National	City / Region	Companies	Household
CR1	1	Share of publicly purchased products following EU GPP criteria				X		
CR4	2	Share of public procurement notices that stipulate specific CE aspects				X		
CR8	3	Budget of public procurement notices that stipulate specific CE aspects				X		

2. INDICATOR 1: SHARE OF PUBLICLY PURCHASED PRODUCTS FOLLOWING EU GPP CRITERIA

This indicator is used to measure the share of publicly purchased products and services following EU Green Public Procurement (GPP) criteria.

The EU GPP criteria is set within the framework of **Strategic Public Procurement, together with Socially Responsible Public Procurement (SRPP) and Innovation Procurement,** with the purpose of providing clear, verifiable, justifiable and ambitious environmental criteria to enable sustainable public procurement. This reinforces key aspects of circularity through consideration of material origins, durability, recyclability and lifecycle assessments (EU Commission, 2024). The European Commission (EC) has defined voluntary GPP criteria for the following product groups:

- EU GPP Criteria for Computers, monitors, tablets, and smartphones (EU Commission, 2021)
- EU GPP Criteria for Data centres, server rooms and cloud services (EU Commission, 2020)
- EU GPP Criteria for Electricity (EU Commission, 2012)
- EU GPP Criteria for Food, catering services and vending machines (EU Commission, 2019)
- EU GPP Criteria on Furniture (EU Commission, 2017)
- EU GPP Criteria for Indoor cleaning services (EU Commission , 2018)
- EU GPP Criteria for Office building design, construction and management (EU Commission, 2016)
- EU GPP Criteria for Paints, varnishes and road markings (EU Commission, 2018)
- EU GPP Criteria for Public space maintenance (EU Commission, 2019)
- EU GPP Criteria for Road design, construction, and maintenance (EU Commission, 2016)
- EU GPP Criteria for Road lighting and traffic signals (EU Commission, 2018)
- EU GPP Criteria for Road Transport (EU Commission, 2021)
- EU GPP Criteria for Textile products and services (EU Commission, 2017)

Following the adoption of the 2020 Circular Economy Action Plan (CEAP), the EC has proposed introducing minimum mandatory GPP criteria and targets in sectoral legislation, and to phase in compulsory reporting to monitor uptake. Therefore, this indicator could provide a readily understood metric to benchmark and monitor the performance of cities and regions in applying GPP approaches across the EU.

Despite challenges in data collection, there are several benefits to monitoring this indicator, for example:

- It is supportive of the CEAP's objective to introduce minimum mandatory GPP criteria and targets in sectoral legislation, and the accompanying phase in of compulsory reporting to monitor uptake.
- It provides an easily understood metric that can be used to measure compliance with, and enforcement of, sustainability requirements set by EU directives and sectoral legislation in the public procurement of goods at the regional and local level.
- It promotes the harmonisation of sustainable public procurement practices at the municipal and regional level.
- It enables local and regional policymakers to benchmark their sustainable public procurement performance against peers at the national and European level. This provides insights into sustainable procurement policy effectiveness, further guiding targeted policy development.

2.1   KEY METHODOLOGY

2.1.1   Testing method

The system boundary for this indicator applied to the monitoring of public procurement notices following EU GPP criteria that have been published by one municipal administration (the Municipality of Lund, Sweden), and one regional government (the Government of Catalonia, Spain) in the time period: 1st January 2023 to 31st December 2023.

The region of Catalonia was selected due to their prior work in promoting sustainable public procurement practices. As a populous region (7.98 million[1]), with a significant economic output (€292.5 billion[2]), their autonomous status means it has some scope to set its own legislative agenda. Since 2005, this has led to environmental criteria being included within most framework agreements used by the Government of Catalonia. In addition, the government has also produced GPP guides for products and services that are usually contracted or purchased on a decentralised basis. As such, it was assumed this case study may represent a suitable location to test this indicator.

As a smaller city, the Municipality of Lund allowed the research team to test the feasibility of monitoring this indicator on a smaller scale. Having set targets to embed circular and sustainable procurement practices in their Climate Neutral Lund 2030 strategy, published in January 2022, this would also provide insights into the rate at which these changes can be implemented at the local level (Lunds Kommun, 2022).

The scope of the research was restricted to monitoring public procurement notices for the purchasing of textile products and categorised using the Common Procurement Vocabulary (CPV) code: 18000000-9 - Clothing, footwear, luggage articles and accessories, on the basis of feasibility. The EC has published 14 GPP guidance documents specifying criteria for product groups typically purchased by public bodies, which vary in terms of complexity and requirements as they address specific environmental challenges associated with each product group. As the *EU GPP criteria for Textile products and services* (2017) contains a comparatively lower number of requirements compared to other GPP criteria, it represented the most effective means of trialling this testing methodology for this indicator. While focusing on CPV codes associated with textile products, rather than CPV codes associated with textile services limits the scope of results generated, it does reduce uncertainties surrounding potential data gaps and subsequent data analysis.

To automate this process, the research team deployed a web-scraping tool, which used digital methods to extract data from online platforms/databases using digital software. Web-scraping is a process that involves "fetching the data" where a webpage is downloaded, before data is "extracted", thereby allowing the webpage's contents to be searched, reformatted, and analysed in a relatively efficient manner. In this case, web-scraping was used to extract and download procurement data from public procurement platforms/databases associated with each area of study and assess the presence of predetermined key terms indicating the use of EU GPP criteria for textiles.

This process required the use of downloadable PDF documents therefore, public procurement notices without such documents on the platforms/databases were excluded. In the case of the Region of Catalonia, this applied to a very high proportion of notices classified as "Minor Contracts" (low value contracts) on the Platform for Public Procurement for Catalonia website. As such, they were all excluded to ensure consistency.

This web-scraping process was conducted in five stages (detailed further down below):

1. Defining key terms related to EU GPP criteria for textiles.
2. Scraping procurement website.
3. Downloading relevant PDF documents.
4. Performing an automated PDF analysis to extract specific information from the relevant tender documents matching key terms.
5. Fuzzy matching (defined below) and quality assurance.

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[1] Statista, "Population of the Spanish autonomous community of Catalonia in 2023, by age group". (Statista.com, 03/11/2024), https://www.statista.com/statistics/448882/population-of-catalonia-by-age-group/. Accessed: 09/04/2024

[2] Statista, "Gross domestic product (GDP) in Catalonia between 2003 and 2023". (Statista.com, 03/04/2024), https://www.statista.com/statistics/327097/gross-domestic-product-in-catalonia/. Accessed: 09/04/2024

2.1.1.1   Defining key terms related to EU GPP criteria for textile products

Key terms for the assessment of GPP criteria were identified through a review of both the Swedish and English-language versions of the *EU Green Public Procurement Criteria for Textile products and services* (EU Commission, 2017). They were selected on the basis of their relevance to GPP criteria for textile products, significance and frequency of use.

All procurement documents and processes in the region of Catalonia are written in Catalan as this is the official language of the region. As no EU Green Public Procurement guidance document exists in Catalan, these terms were translated using translation software, and cross referenced with the following guidance documents to ensure that terminology used remained consistent between each city and region:

- Department of Climate Action, Food and Rural Agenda of the Government of Catalonia, *Guide to the procurement of environmentally correct textile products* (2023)[3]:
- Department of Climate Action, Food and Rural Agenda of the Government of Catalonia, *Guide to the parameterization of environmental criteria to be considered in public procurement* (2023)[4]:

The way in which these key terms in Catalan have been translated are listed in Table 2 below. As it was not possible to access a procurement platform for the Municipality of Lund, these key terms have not been listed here.

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[3] Translated from Catalan to English – the original title in Catalan: Guia de la contractació de productes tèxtils ambientalment correcta.

[4] Translated from Catalan to English – the original title in Catalan: Guia de parametrització de criteris ambientals a considerar en la compra pública

Table 2: Summary of key terms for GPP for textiles, translated in English and Catalan (Generalitat de Catalunya, 2023)

Key GPP categories identified in Catalonia GPP guidance documents	Key terms identified per category	English translation
Serveis de rentat: Detergents amb etiqueta ecològica	Etiqueta ecològica Segells tèxtils ecològics	Ecological label Ecological textile stamps
Serveis de rentat: Consum d'energia	Consum d'energia	Energy consumption
Serveis de rentat: Rendiment del sistema de recollida i millores aplicades	Sistema de recollida i millores aplicades Sistema de recollida Separació i la classificació dels productes tèxtils Separació després de la recollida Maximitzar el valor obtingut de la reutilització o el reciclatge	Collection system and improvements applied Collection system Separation and classification of textile products Separation after collection Maximise the value obtained from reuse or recycling
Serveis de rentat: Teixits que minimitzen l'ús d'energia (assecat i planxat)	Minimitzen l'ús d'energia	Minimise the use of energy
Serveis de rentat: Etiquetatge per fomentar el rentat a baixa temperatura	Rentat a baixa temperatura	Wash at low temperature
Mínim del 20% del contingut de productes de polièster reciclat	Polièster reciclat material reciclat	Recycled polyester Recycled material
Disseny per al reciclatge de polièster	Disseny per al reciclatge de polièster	Design for polyester recycling
Declaració de la inclusió en la llista de substàncies candidates REACH	la llista de substàncies candidates REACH	REACH candidate substance list
Absència o limitació de contaminants (formaldehid, crom VI, pentaclorfenol, tetraclorofenol…)	Absència o limitació de contaminants Article 33, apartat 2, de REACH Llista de substàncies candidates de REACH	Absence or limitation of pollutants Article 33, paragraph 2, of REACH REACH candidate list of substances
Mínim del 60% del contingut dels productes de cotó ecològic o amb gestió integrada de plagues (GIP)	Gestió integrada de plagues (GIP) Cotó ecològic	Integrated Pest Management (IPM) Organic cotton
Durabilitat del producte segons assajos	Durabilitat del producte	Durability of the product
Disponibilitat d'accessoris o parts	Disponibilitat d'accessoris o parts Manteniment Allargar al màxim la via útil Prestació de reparacions Substitució de peces trencades	Availability of accessories or parts Maintenance Extend the useful path to the maximum Provision of repairs Replacement of broken parts

Key GPP categories identified in Catalonia GPP guidance documents	Key terms identified per category	English translation
	Substitució de peces perdudes Serveis per reparar	Replacement of lost parts Services to repair
Disseny per a la reutilització i el reciclatge	Disseny per a la reutilització i el reciclatge Reutilització Contingut reciclat mínim Matèries primeres reciclades Certificació de tercers del contingut reciclat	Design for reuse and recycling Reuse Minimal recycled content Recycled raw materials Third party certification of recycled content
Disponibilitat d'un sistema de gestió ambiental (ISO 14001, EMAS…) o bones pràctiques ambientals	Sistema de gestió ambiental (ISO 14001, EMAS…) Origen de les fibres tèxtils Traçabilitat de l'origen Gestió de productes químics Sistema de conformitat Sistema de certificació Contingut en cotó ecologic Contingut en fibres de cotó ecològic	Environmental management system (ISO 14001, EMAS...) Origin of textile fibres Traceability of origin Management of chemical products Compliance system Certification system Organic cotton content Content of organic cotton fibres
Compliment de criteris de certificats o segells tèxtils ecològics (OEKO-TEX, GOTS- Global Organic Textile Standard…)	Certificats ecològics Segells tèxtils ecològics OEKO-TEX GOTS/ Global Organic Textile Standard	Ecological certificates Ecological textile stamps OEKO-TEX GOTS Global Organic Textile Standard

2.1.1.2 Scraping procurement website

The web-scraping process was initiated by opening the target procurement website and navigating through it to extract and download procurement notices based on the predefined CPV code. This process is detailed in the 04_scrapper_ALL_CPV.py script (a web-scraping tool) provided in Appendix 5.6. This step downloaded all relevant data associated with textile procurement notices, including publication date and value, and therefore enabled the research team to quantify the total value of these notices.

This process followed the following key steps:

- **Setup:** Selenium WebDriver (a browser plug-in) was used to automate browser interactions, with ChromeDriver (an open source tool for testing webapps) configured to handle downloads.
- **Accept Cookies/T&Cs:** The script navigated to the search page of the procurement website and programmatically accepted cookies or terms and conditions to proceed.
- **CPV Codes Iteration:** The script iterated over a list of CPV codes, performing searches to gather procurement notices related to these codes.
- **Data Extraction:** For each CPV code, the script scraped relevant data from the search results, including expedient codes (file identifiers), tender procedures, and links to detailed notice pages.
- **Exclusion of Minor Contracts:** Notices tagged as 'minor contracts' by a public procurement platform were excluded from the process due to the lack of downloadable PDF documents necessary for key term matching.

2.1.1.3 Downloading PDF documents

Following the initial scraping, all the PDF documents available associated with each non-excluded procurement notice were downloaded. This script can be found in Appendix 5.6. This included downloading the listed technical specifications, justifications, contracts and evidence associated with each identified procurement notice's expedient code.

This process followed the following key steps:

- **Iteration Over Notices:** The script iterated over the previously scraped data, visiting each notice's detail page.
- **PDF Links Identification:** It identified links to downloadable PDF documents based on the document type (e.g., technical specifications documents; "Plec de prescripcions tècniques" in Catalan).
- **PDF Download:** Relevant PDF documents were downloaded and saved in a structured directory based on CPV codes and expedient codes.

2.1.1.4 Performing an automated PDF analysis to identify key terms

The 06_pdf_analysis.py script provided in Appendix 5.6 analysed the downloaded PDF documents for the matching the key terms, extracting specific information to quantify the results of this indicator, such as the frequency of key term use, and their specific location in supporting documentation, which enables further quality assurance processes.

2.1.1.5 Fuzzy matching and quality assurance

Fuzzy matching, which is a web-scraping technique to review strings of text for similarities, was applied where exact matches between data fields were not feasible due to variations in naming conventions or typos. A matching criterion of 95% was set to ensure that as close a match to the key terms was made as possible, while allowing for variation. This approach enhanced data matching accuracy beyond simple string comparisons. Following this, a manual check of the expedients identified was conducted to ensure the accuracy of the results.

2.1.1.6 Output from Testing method

All the data from each of these steps were combined within an Excel a spreadsheet for further analysis, which allowed the research team to calculate the results for this indicator.

2.1.2 Data collection method

This indicator had the following data requirements:

- The total number of public procurement notices published in the period of January to December 2023 that were categorised within the CPV code 18000000-9 for Clothing, footwear, luggage articles and accessories.
- The number of public procurement notices following EU GPP criteria published in the period of January to December 2023 that were categorised within the CPV code 18000000-9 for Clothing, footwear, luggage articles and accessories.
- The value (in €) of each public procurement notice published in the period of January to December 2023 that were categorised within the CPV code 18000000-9 for Clothing, footwear, luggage articles and accessories.

To collect this data, the research team carried out initial desk-based search to identify data sources and relevant procurement officials in both Lund and Catalonia to ensure access to procurement data and to sense-check findings once data collection was complete.

2.1.2.1 Desk-based research

Desk-based research was conducted to identify public procurement platforms used by each case study city and region.

To identify relevant stakeholders, the research team carried out desk-based review of public procurement policy statements, reports, briefing notes, conference itineraries relevant to each city/region's sustainable procurement policies, as well as regional procurement agencies. Once a stakeholder had been identified, these were evaluated for relevance according to area of responsibility and how up to date the data source was.

Initial search terms used (translated into official language of region using DeepL):

- ("Green public procurement" OR "Sustainable procurement" OR "Circular procurement") AND ("Department" OR "agency") AND ("City" OR "Region")

Additional data sources reviewed:

- LinkedIn groups, such as the Circular Procurement Learning network, to identify relevant stakeholders.
- Open tender: contains tender data for EU Member States and regions.
- Eurostat: Eurostat will be adding EU GPP criteria to the CE monitoring framework from 2024. They were to be contacted to understand what data sources were being used for this.

2.1.2.2 Stakeholder engagement

The research team conducted one 60-minute interview with relevant stakeholders from the Municipality of Lund and one interview with relevant stakeholders of the Government of Catalonia's public procurement services.

The interview had three objectives:

- To ensure that the research team had identified the correct data sources.
- To request quantitative data relevant to this indicator.
- To understand the perceived challenges and long-term aspirations of each city/region in relation to measuring this indicator.

In the case of the Government of Catalonia, key stakeholders interviewed included representatives from the following departments of the Government of Catalonia's public procurement services: Public Procurement, the Regulation and Supervision of Public Procurement, the Public Procurement Consultative Board of Catalonia and Centralised Purchasing. During this interview, the research team confirmed that the terms used (noted in Table 2) were accurate and relevant, and that the most relevant public procurement platform that should be used was the Plataforma de Serveis de Contració Publica (referred to throughout as the Public Procurement Platform of Catalonia)[5].

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[5] Paltaforma de Serveis de Contractació Pública, "Public procurement services of Catalonia Platform use data" (https://contractaciopublica.cat/en/inici, 2024). Plataforma de Serveis de Contractació Pública (contractaciopublica.cat). Accessed: 01/04/2024

Following the interview, the research team developed the web-scraping tool, downloaded all relevant metadata for the period of January to December 2023 from the Public Procurement Services of Catalonia platform and conducted the testing of this indicator.

In the case of the Municipality of Lund, key stakeholders interviewed included representatives of the Municipality of Lund's Public Procurement department. During the interview, key terms were confirmed as relevant, however, the municipality were not able to provide access to a local public platform where relevant metadata could be downloaded. This was because the municipality uses the Adda platform, a procurement service operated and used by the majority of Sweden's municipalities, for the management of their procurement services[6]. The research team contacted Adda to request access to data specific to the Municipality of Lund. However, due to commercial sensitivities, they were not able to provide access to the research team, nor share details on which contracting authority had procured goods from specific frameworks. To mitigate this data gap, the research team distributed a survey to public sector organisations within the legal boundaries of Lund to collect the data needed.

2.1.3 Calculations

To calculate this indicator, the following formula was used:

$$CR1: Share\ of\ public\ procurement\ notices\ that\ contain\ GPP\ criteria$$
$$=$$
$$\frac{Tenders\ containing\ GPP\ criteria\ and\ key\ terms\ (in\ €)}{Total\ number\ of\ tenders\ (in\ €)}$$

2.1.4 Timeline

Table 3 shows the sequence and timeline of activities conducted during research.

Table 3: Gantt chart to describe project timeline

Week Commencing	01-Jan	08-Jan	15-Jan	22-Jan	29-Jan	05-Feb	12-Feb	19-Feb	26-Feb	04-Mar	11-Mar	18-Mar	25-Mar	01-Apr
Review Green Public Procurement Action Plans	░													
Desk-based research to identify data sources	░	░	░	░	░									
Engage stakeholders		░	░	░	░									
Public procurement surveys							░	░	░	░				
Development & application of Web-scraping tool.							░	░	░	░				
Analysis and write up											░	░		
Review period							■			■			■	
Key deliverables											◆		◆	

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[6] Adda Inköpscentral, "Om oss" (https://www.adda.se, 2024). https://www.adda.se/om-oss/about-adda/. Accessed: 01/04/2024

2.1.5   Data gaps and mitigation

Table 4 summarises the data gaps and mitigations associated with testing this indicator.

Table 4. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	The following of EU GPP criteria is currently not being monitored in a systematic or robust manner.	• The research team used a web-scraping tool to identify the presence of specific EU GPP terms used within tender documents listed on digital public procurement databases.	High
2	At the national level, the Open Tender and Tenders Electronic Daily (TED) databases register all tenders above EU thresholds however, there are values missing and no standard format.	• Where limited information was found online, the research team engaged with public procurers from the relevant municipalities and regions to verify findings and sources of information. • Development and application of web-scraping tool to automate quantification of public procurement notices containing EU GPP criteria.	High
3	No access to Lund public procurement database.	• Attempts to conduct stakeholder surveys of public sector organisations in the city were made to request estimations on the number of public procurement notices containing EU GPP criteria. • 61 organisations were emailed however, no responses were received. Therefore, it was not possible to quantify this indicator for the region of Lund.	Low
4	Terminology for GPP criteria may vary across languages.	• The research team used the EU GPP guidance documents in English and cross referenced this with the Swedish version to ensure that terminology remained consistent. • The research team used digital software to translate terms from the Spanish EU GPP guidance documents, and cross referenced these with EU GPP guidance documents published in Catalan by the Government of Catalonia.	Medium

2.1.6   Quality review of analysis

To ensure robust and high-quality results, Ricardo conducted the following data validation and quality control procedures:

- Prior to work beginning, the Project Director reviewed the proposed research methodology and ensure that the data collection plan is fit for purpose. Once the research team addressed any comments from the review process, they proceeded to the data collection phase.

- The research team built an MS Excel database to record relevant procurement data for publicly purchased products following EU GPP criteria for each case study city. This was reviewed by the Project Director prior to analysis being conducted.

- The research team presented semi-structured interview guides and a list of stakeholders identified for interview to the Project Director for review prior to interviews being carried out.

- The Project Director held responsibility for the quality of the final case study output. During the review period, the Project Director and senior subject matter experts were involved in judging the quality of the output and suggesting ways to improve.

2.2   KEY ANALYSIS RESULTS

2.2.1   Analysis

Table 5 below presents the share of the value of publicly purchased textile products following EU GPP criteria for the Government of Catalonia for the period January 2023 to December 2023. As noted in Section 2.1.5, no data was available for the Municipality of Lund.

Table 5: Summary of results for indicator CR1

	Government of Catalonia
Total value of publicly purchased textile products following EU GPP criteria	€667,193.53
Total value of publicly purchased textile products (excluding minor contracts)	€3,716,686.35
Share of publicly purchased textile products following EU GPP criteria	17.95%

Table 6 below presents the analysis of publicly purchased textile products in the Region of Catalonia for the period January 2023 to December 2023.

Of the 287 public procurement notices that were categorised for textile products (CPV code18000000-9), 257 were listed as "minor contracts" and therefore excluded from analysis, leaving 30 notices for analysis. Of these, 13 public procurement notices were identified as containing at least one key term match with the listed EU GPP criteria for textile products. The research team then conducted a review of each identified notice's listed supporting documents to assess whether these contained a true match. As a result of this process, three notices were excluded. In two cases, this was due to a false match with the term "maintenance", which within the procurement notice referred to maintenance teams, rather than a product life extension service design, while another notice had a false match with "compliance system", which within the notice's supporting documents referred to compliance with "CE Markings" rather than compliance with an environmental standard.

As a result, the research team was able to assess that 10 of the 30 notices within the scope of this study contained EU GPP criteria for textiles. These had a total value of €667,193.53 and represented 17.95% of the value of all non-minor notices listed in the Government of Catalonia's public procurement platform.

Please note that the 257 minor contracts which were excluded from this study represented a total value of €294,058.77 (7.33% of the total value of all expedients), meaning that their exclusion did not significantly impact the results of this indicator. Nonetheless, these still represent a significant volume of procurement activity where it was not possible to automate the monitoring of the presence of GPP criteria due to the absence of supporting documents (e.g. technical specifications) that can be analysed. This could represent a potential cause for concern, as in other product categories the total value of minor contracts is significantly higher (e.g. the total value of minor contracts for CPV code 44000000-0 – Construction structures and materials represent 49.23% of the total value for the notices for the period January to Decembre 2023). Therefore, these exclusions

may undermine the acceptability of any results generated for this indicator as they may be perceived to provide an incomplete picture of procurement activities.

Table 6: Analysis of publicly purchased textile products in the Region of Catalonia following EU GPP criteria

Analysis	Number	Value
Total expedients	287	€4,010,745.12
Total minor contracts	257	€294,058.77
Total expedients for analysis	30	€3,716,686.35
Total expedients meeting GPP criteria from automated process	13	€1,065,566.29
Total expedients meeting GPP criteria after manual check	**10**	**€667,193.53**
Share of expedients meeting GPP criteria for analysis	**33.33%**	**17.95%**

2.2.2 Limitations

One limitation of the methodology is that it focuses on procurement events, such as Invitations to Tender (ITTs) and Requests for Proposals (RFPs). As such, this may have a distorting effect depending on the length of the contracts. For example, some contracts last for several years. If one of these happen to be for a high spend category, and contains GPP criteria, it will skew the indicator in that year. This can be mitigated by looking at spend rather than the event of these notices, which may be difficult to implement. Alternatively, it could be mitigated by looking at several years at once rather than targeting one year, which would be easier to achieve but may limit year on year comparisons. This limitation does not affect the concept of the indicator itself, but rather its possible implementation.

In the case of the Government of Catalonia, while the research team was able to identify a number of public procurement notices listed on the Public Procurement Platform of Catalonia, there are some limitations and uncertainties associated with this data:

- To ensure the research was feasible within the time allocated, the scope of the research was restricted to assessing the number of public procurement notices for textile products adhering to the EU GPP for textile criteria. This excluded notices pertaining to textile services so as to reduce the potential of additional data gaps and the creation of potential uncertainties in the assessment of the testing methodology itself. To test for textile services, future researchers may seek to include all relevant CPV codes for washing and dry-cleaning, laundry collection and management, upholstering and other textile services within the web-scraping script described in 2.1.1.2. This will identify the total number of expedients relevant to each CPV code, and subsequently which expedients may or may not contain EU GPP Criteria.

- Future assessments may seek to apply this testing methodology to assess a broader range of EU GPP criteria including EU GPP Criteria for Food catering services and vending machines (2019), EU GPP criteria on Furniture (2017), and EU GPP criteria for Office building design, construction and management (2016).

- In addition, the government stakeholders interviewed noted the potential of inconsistencies in how the CPV codes used to categorise each notice had been uploaded to the platform. This is due to the fact that each municipality within the region was responsible for uploading data to the platform and it was challenging to standardise each municipality's practices and eliminate human error. It was recognised that more training and guidance may be needed to reduce this in the future. Nonetheless, no mitigation activity was carried out as this risk was deemed not to be significant.

- Due to availability issues, it was not possible to conduct a follow-up interview to sense-check findings with representatives once analysis had been completed, reducing the opportunity to either identify potential anomalies in the data assessed or the practicality of stakeholders within the administration of using this method in their own processes.

- Finally, the exclusion of 257 minor contracts from analysis represents a critical gap in the data collection process. While a representing a relatively minor share of the total value of notices within this

product category (7.33%), their exclusion from the analysis could skew results and lead to the underreporting of GPP compliance in future assessments of the procurement activities of local and regional administrations. Future research should therefore seek to develop methodologies to mitigate these data gaps in the future.

To mitigate issues surrounding data availability, the research team conducted an email survey of 13 administrations in the City of Barcelona and a further 11 municipalities with a population above 72,500 inhabitants in the region of Catalonia to request estimations on the proportion of public procurement notices that contained GPP aspects. This resulted in no responses within the data collection period.

In addition, another limitation was that the EC did not publish EU GPP criteria in Catalan, and as such, key terms identified in the GPP criteria had to be translated from Spanish to Catalan using online software. As such it was acknowledged that there was a potential risk of inaccurate translations. To mitigate this risk, the research team reviewed the GPP guidance materials produced by the Government of Catalonia and discussed these with relevant stakeholders to ensure translated terminology used in the web-scraping tool were consistent with the terms contained within the government approved guidance documents. This may affect the replicability of this methodology, as future research teams may encounter similar challenges when conducting research in other administrations where the official language used by procurement officials and processes are not aligned with the official languages of the EU.

In the case of the Municipality of Lund, the efforts to test this indicator produced no results due to the way in which procurement practices in Sweden are managed, namely how commercial contract information can be accessed via the intermunicipal procurement platform, Adda. Attempts to mitigate this through the use of a survey targeting stakeholders in 61 public sector organisations in the city of Lund also resulted in no response within the data collection period. Therefore, this indicator could not be measured for that region and the analysis could not be compared with results from other EU Member States.

Finally, it is important to consider the limitations of web-scraping more broadly as an approach to monitoring this data. As noted in Section 2.1.1, web-scraping scripts are developed to match the specific architecture/layouts of the websites they are designed to extract data from. As websites often change their layouts, this can require web-scraping scripts to be frequently updated to avoid them breaking. In addition, this might not be easily scalable across different regions or products due to varied data availability and technology, as it would require a fairly high level of technical expertise that might not be readily available. Even with web-scraping, there may also be gaps in data coverage due to differences in how procurement notices are published or archived. This methodology is therefore limited by a dependency on published data. As indicated by the exclusion of minor contracts in this study, this may result in incomplete datasets as all relevant transactions may not be publicly disclosed or documented.

In terms of implementation, future monitoring efforts should also consider limitations imposed by external factors on the availability of data. The impact of the current economic climate, alongside the impact of public budgets, can influence the extent to which GPP criteria are prioritised or implemented by public administrations, both in terms of spend on GPP compliant products and services, as well as in terms of resources invested in monitoring their presence in public procurement.

It is understood that Eurostat will be seeking to include GPP monitoring as part of the CE monitoring framework from 2024 onwards. During the data collection phase, the research team did not receive a response from Eurostat on the methodology or processes that will be applied to implement these changes. Nonetheless, outcomes from this work would be considered useful for the future monitoring of this indicator.

2.2.3 Performance

Table 7 below compares the RACER score allocated to the original indicator during Task 4 against the final indicator after the Task 5 testing process. During Task 4, the original indicator was allocated a score of 12 against the RACER evaluation process. Following testing of the feasibility and practicality of measuring this indicator n Task 5, the indicator was allocated a score of 10, for the reasons summarised below:

- **Relevance**: This refers to whether the indicator is closely linked to the objectives to be researched. From analysis of the web-scraping results for Catalonia, there was evidence that it was possible to monitor the number of public procurement notices containing requirements for GPP criteria, such as

recycled content, EU ecolabels, and design for durability. As such, the score of "Good" (3) remained unchanged as it was assessed to be fully aligned with EU policy objectives.

- **Acceptability**: This refers to whether the indicator is perceived to be of value to, and used by key stakeholders, such as procurement stakeholders within local and regional administrations. Through stakeholder engagement it was noted that the benefits of monitoring this indicator were clear and both reported interest in understanding how this could be measured in the future. At the same time, both noted that current challenges in relation to collecting data remained a significant barrier. As such, the score remained as "Neutral" (2) following testing.

- **Credibility**: This refers to whether the indicator is transparent, trustworthy and easy to interpret. While this indicator was easy to understand and to communicate to stakeholders, it was found that there was no easily applicable methodology that could be adopted by municipalities. This was due to the clear differences in the way in which local and regional administrations manage public procurement. While on the one hand, web-scraping greatly improved the way in which data can be collected, this would need to be enabled by cities and regions standardising their procurement systems to allow monitoring to be rolled out across cities and regions across EU Member States. As such, scoring for Credibility has been downgraded to "Neutral" (2).

- **Ease**: This refers to the easiness of measuring and monitoring the indicator. The score was downgraded to "Poor" (1). While the use of the web-scraping tool allowed the research team to download and assess data from the Government of Catalonia's public procurement platform with relative ease, this process was not possible in the case of Lund due to the use of the Adda platform which did not allow access to the data needed to assess this indicator.

- **Robustness**: This refers to whether data assessed is biased and whether it comprehensively assesses circularity. The score remained unchanged as "Neutral" (2). Despite the noted challenges in collecting data for reporting, this remained a one-dimensional indicator with a consistent methodology.

Table 7. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	**Acceptability**	**Credibility**	**Ease**	**Robustness**	
Task 4 (original RACER assessment)	3	2	3	2	2	12
After Task 5 (following testing)	3	2	2	1	2	10

2.3   CHALLENGES AND LESSONS LEARNED

2.3.1   Challenges

2.3.1.1   *Data availability*

This was a challenging indicator to monitor as there is currently no legislative requirement for cities or regions to publicly disclose the number of public procurement notices that meet EU GPP criteria. As such, neither the Municipality of Lund nor the Government of Catalonia had access to comparable data to monitor this indicator.

Indeed, during the interview with representatives of the Government of Catalonia's procurement departments, it was found that the administration was not measuring and not envisioning to measure the application of GPP criteria in public procurement. While the government has developed GPP guidelines for procurement, these are not mandatory, and there is currently no monitoring of whether or how municipalities within the region are seeking to apply these in their local procurement practices. Please note that the Government of Catalonia monitors the presence and value of "environmental clauses" in public procurement contracts, but these are not defined by product category or type of clause[7]. Following stakeholder engagement, it was found that this data would not be a suitable proxy for this indicator.

In the case of Lund, municipality representatives noted that the use of a web-scraping tool might not be feasible for the monitoring of GPP criteria in procurement notices. While the Municipality would have access to public procurement notices related to the purchasing of uniforms for street cleaners and maintenance workers, the majority of public sector procurement activities are being conducted via the Adda procurement platform and issues surrounding data access was perceived as a challenge.

Through email correspondence with a representative of the Adda procurement platform, it was noted that while they offer workwear framework agreements that contain specific sustainability requirements aligned with EU GPP criteria, they currently do not monitor whether the municipalities/regions that procuring through the framework agreement have chosen to purchase from suppliers that meet these criteria. In addition, the representative noted that it was not possible to release information about which contracting authorities have made contracts through the frameworks they provide due to commercial sensitivities.

These findings demonstrates that local and regional administrations across EU Member States have developed different systems to manage and monitor procurement activities, and it is expected that barriers regarding data availability will be a consistent issue affecting future monitoring efforts if public procurement processes are not harmonised across the EU. In particular, the lack of standardised data formats across different procurement platforms will likely complicate data aggregation and analysis.

2.3.1.2   *Data completeness*

The analysis was restricted to assessing only the public procurement notices listed on the Public Procurement Platform of Catalonia that had been uploaded with supporting documents in a PDF format. This meant that 257 of the 287 listed notices for textile products could not be assessed, and while they represented just over 7% of the total value of purchased textile products, this represents a significant portion of activity that cannot be monitored using the methodology deployed in this study. These limitations should be acknowledged if this methodology was applied to monitor this indicator to improve the public acceptability of results.

2.3.1.3   *Data quality*

Due to the low number of public procurement notices that were identified during the automated monitoring process (13) it was possible to conduct a full manual QA check of the results. However, this process was time consuming and may not be suitable in cases where there is a significant number of identified notices that contain key terms matching GPP criteria. As such, future research will need to develop a QA methodology where manual checks are not feasible.

2.3.1.4   *Stakeholder engagement*

It is understood that stakeholders may have limited time and resources to contribute to future research and monitoring efforts, which can affect the quality and completeness of the information gathered. Nonetheless,

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[7]   Generalitat de Catalunya, "Contratació pública: Clausulas ambientales" (Contratacio.gencat.cat, 2023) https://contractacio.gencat.cat/ca/difusio/publicacions/indicadors/grafics/clausules-ambientals-en/. Accessed: 01/04/2024.

their input is an important factor in mitigating issues surrounding data availability and quality. Stakeholder engagement should therefore be prioritised in future indicator development.

2.3.2 Lessons learned

In the case of the region of Catalonia, the application of a web-scraping tool greatly facilitated the ease with which the indicator was monitored and results analysed. The modular functionality of the tool allowed the research team to take an iterative approach to organising the metadata downloaded, refining key search criteria, and conducting manual quality assurance review.

While this approach is replicable, it should be noted that each web-scraping tool is essentially bespoke as they are designed to navigate the architecture of specific websites or databases and it is not possible to reapply these tools between websites or databases. As such, if this method is applied in future assessments, then future research teams will need to designate time in designing individual web-scraping tools per database. In the case of Catalonia, the research team benefited from the fact that procurement notices were publicly listed on a platform that was free and open to access. In the case of Lund, this was not possible, as access to the Adda platform was restricted due to commercial sensitivities.

Therefore, future research teams wishing to test the feasibility of using web-scraping as a method to monitor this indicator will need to follow one of two approaches, either:

- Identify local and regional administrations that operate publicly accessible procurement platforms, and contain tender specifications and/or supporting evidence relevant to the indicator being assessed. For example, during initial desk-based research it was found that several regional and national administrations operate publicly accessible procurement platforms similar to the Catalonian Public Procurement Platform. These include Nantes Metropole[8], the Spanish government and other regional administrations in Spain[9].

- Alternatively, research teams may reach out to the operators of restricted procurement platforms, such as Adda, to gauge interest in participating in similar research in the future.

Therefore, future mitigation efforts should seek to factor in a longer stakeholder engagement period.

Finally, it should be noted that while the research team was unable to gather data on the number of tenders containing GPP criteria for textile products in the case of Lund, they were able to gain proxy data for the indicator FWN2 (Share of criteria containing organic food requirements) by requesting purchasing data for contacts containing organic food criteria. As this purchasing data was being monitored, this approach produced valuable results and therefore may be viable to mitigate potential data gaps in the future.

2.4 CONCLUSIONS AND RECOMMENDATIONS

> **It is recommended that this indicator is considered for further development, with significant work required to facilitate its progress.**

Testing of this indicator has demonstrated that it is feasible to measure this data and despite some limitations it is considered suitable for future development. However, this would require significant coordination work and capacity-building to enable cities and regions to effectively monitor this indicator in a systematic and coherent manner. This is due to key differences in terms of data availability and public procurement platforms used across EU Member States. Nonetheless, there are several drawbacks of using this indicator. These include the fact that there is no EU GPP criteria, some EU are partially outdated, and that these EU GPP criteria will tend to become more outdated as the EC has decided to stop updating these due to the policy preference of establishing mandatory GPP criteria in sectoral legislation. There may be also concerns that some public buyers use GPP criteria that are more ambitious than the EU GPP criteria.

This does not negate the need to monitor the extent to which sustainable criteria are being integrated into public procurement practices. Indeed, while the Government of Catalonia has been recognised for setting high standards and guidance for GPP, two thirds of the expedients assessed contained no GPP criteria whatsoever.

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[8] Nantes Metropole, "MARCHES PUBLICS DEMATERIALISES" (marchespublics.nantesmetropole.fr, 2024). https://marchespublics.nantesmetropole.fr/entreprise. Accessed 01/04/2024

[9] Gobierno de Espana, "Plataforma de Contratación del sector Público" (contrataciondelsectorpublico.gob.es/, 2024) https://contrataciondelsectorpublico.gob.es/wps/portal/licitaciones. Accessed: 01/04/2024

While some public buyers may be more ambitious than the EU criteria, it is also true that these tend to be outliers, and there will still be a need to incentivise the uptake of sustainable procurement practices by cities and regions. To ensure compliance with any new policy development that seeks to integrate GPP criteria into national/sectoral legislation or EU directives, the EC will need to consider a reporting mechanism to ensure these changes are being implemented. For example, the revision of the EU procurement directive to include mandatory reporting requirements on GPP compliance for all public sector contracts above a certain value.

In the development of this indicator, web-scraping was used as an innovative tool to monitor the adherence to GPP criteria. This allowed the research team to download all relevant metadata from the Catalonian Public Procurement Platform, iterate search terms and refine the scope of analysis to identify notices relevant to the product category studied (CPV code 18000000-9 for textile products). As a result, it was possible to calculate that the total share of publicly purchased textile products following EU GPP criteria represented 17.95% for this product category for the Region of Catalonia. Future testing may seek to test the feasibility of monitoring the presence of GPP criteria for other product categories. Testing of EU GPP criteria for textile products was selected due to the moderately limited number of key criteria. For other EU GPP product categories, such as Office building design, construction and management, this process may require more resourcing due to the sheer number and complexity of the criteria present.

During the testing phase, the research team had the support of native Spanish and Swedish language speakers, which greatly facilitated the identification of key criteria within published EU GPP Guidance document. However, due to the absence of EU GPP guidance published in Catalan, these terms were then translated using online translation tools, which then needed to be reviewed by subject matter experts for accuracy. This process required approximately 20% of the budgeted time for the project. Running this study for each GPP category would involve a review of each category's criteria, selecting key terms that are i) unambiguous, ii) true to the key requirement of the criteria, and then ensuring that translations of these terms (into Catalan) remain accurate. Nonetheless, once complete, this initial time investment would only need to be repeated if the key criteria change.

To mitigate this risk, it is recommended that future testing includes stakeholder engagement exercises with public procurement officials to help efficiently identify key criteria that tend to be used with the highest frequency for these product categories.

While this was a good approach for this research to gather and analyse procurement data, its application was primarily exploratory. As web-scraping tools need to be designed to match the specific layout of individual websites and/or databases using consistent terminology and structure, their use may not be feasible to monitor this indicator at the EU level due to the significant technical skills and digital infrastructure that would need to be developed. As such, if the EU were to formally adopt and mandate the monitoring of GPP compliance, it would need to do so through more structured, policy-driven approaches, such as mandatory reporting requirements and greater standardisation within procurement platforms, rather than web-scraping techniques.

It is therefore recommended the EC consider the development of a robust framework for monitoring and evaluating EU GPP criteria implementation that includes clear metrics, regular reporting intervals and standardised assessment procedures. This could be facilitated through the promotion of consistent GPP terminology within tenders across municipal, regional and EU Member State levels. Therefore, the EC may consider funding the development of GPP training materials for local and regional administration procurement professionals across EU Member States. Given the evolving nature of GPP criteria, regular training will need to be conducted with procurement officials on the latest GPP criteria and effective monitoring practices.

Funding may also be required to update local and regional procurement platforms so that they can easily "tag" or categorise public procurement notices containing EU GPP criteria. By upgrading procurement platforms to better manage and analyse GPP data, the EC will be able to promote the adoption of standardised data entry and reporting formats, which will facilitate easier aggregation and analysis of data across EU Member States. To support this approach, it is recommended that the EC provide funding for the development of skills training to allow local and regional administrative procurement officials to develop standardised data entry, reporting and analysis capabilities.

Alternatively, the EC may consider shifting the focus of monitoring from focusing on the presence of GPP criteria in procurement notices, to focus on spend data for products or services purchased. As most procurement platforms and software is able to flag different fields or variables in spend reports, this would help mitigate the need for web-scraping and focus monitoring on real spend on GPP compliant procurement, rather than contracts. While this is unsuitable for testing, this may be relatively easy for implementation.

These approaches are more likely to succeed in EU Member States that have already well-established, coherent procurement platforms, as it is assumed that the organisation and labelling of notices within the platform will be consistent. These may include the public procurement platforms of Nantes Metropole,[10] the Spanish government and other regional administrations in Spain.[11]

The case of the Adda public procurement platform was interesting in that they operate multiple procurement frameworks containing sustainability and CE criteria and are operated by The Swedish Association of Local Authorities and Regions (SKR), which represents all of Sweden's municipalities, county councils and regions. While they were unable to participate in this research, it would be valuable to investigate whether this network would be interested in trialling future GPP monitoring projects as this would generate insights into the practices of every administration of the network. This would provide a clearer understanding the feasibility of monitoring this indicator on a much larger scale. Following the testing of this indicator, it was found that its original name 'Share of publicly purchased products following EU GPP criteria' was fit for purpose and that no variation was needed.

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[10] Nantes Metropole, "MARCHES PUBLICS DEMATERIALISES" (marchespublics.nantesmetropole.fr, 2024). https://marchespublics.nantesmetropole.fr/entreprise. Accessed 01/04/2024

[11] Gobierno de Espana, "Plataforma de Contratación del sector Público" (contrataciondelsectorpublico.gob.es/, 2024) https://contrataciondelsectorpublico.gob.es/wps/portal/licitaciones. Accessed: 01/04/2024

Table 8: Summary of recommendations for indicator CR1

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
Technical review of the implementation of EU GPP criteria in regional procurement practices.	EC to conduct extensive stakeholder engagement exercise with regional procurement officials to understand current challenges in implementing EU GPP criteria, as well as barriers to the introduction of mandatory GPP requirements in sectoral legislation.	Medium (1.5-5 years)	Responsible (R): EC Accountable (A): Municipality and Regional stakeholders responsible for public procurement Consulted (C): Regional procurement platforms C: Circular Economy consultancies C: Digital design consultancies I: Supplier networks	Relevance Acceptance Credibility
Technical review of regional procurement platform capabilities.	EC to conduct stakeholder engagement exercise and gap analysis to assess the capabilities of regional procurement platforms and feasibility of standardising these systems to enable standardisation of data entry, reporting and analysis for this indicator.	Medium (1.5-5 years)	R: EC A: Municipality and Regional stakeholders responsible for public procurement C: Regional procurement platforms C: Circular Economy consultancies C: Digital design consultancies I: Supplier networks	Relevance Acceptance Credibility Ease Robustness
Investment in digital monitoring tools	EC to fund investment in digital tools to enable the automated monitoring of procurement platforms at the city and regional level. This will facilitate the compulsory monitoring of compliance	Medium (1.5-5 years)	R: EC A: Municipality and Regional stakeholders responsible for public procurement C: Regional procurement platforms	Relevance Acceptance Credibility Ease Robustness

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
	with mandatory EU GPP requirements in sectoral legislation.		C: CE consultancies C: Digital design consultancies I: Supplier networks	
Replicate study in other EU cities and regions	EC to conduct additional studies in other EU cities and regions, incorporating a longer stakeholder engagement period to mitigate data gaps and limitations identified in this study. This should include engagement with national procurement platforms, where web-scraping tools may be applied, as well as development of a robust QA methodology to analyse results.	Short (0-1.5 years)	R: EC A: Municipality and Regional stakeholders responsible for public procurement C: Regional procurement platforms C: CE consultancies I: Supplier networks	Credibility Ease Robustness
Development of EU GPP training materials	EC to fund development of EU GPP training materials for municipal and regional government procurement professionals. The aim should be to facilitate the standardisation of GPP terminology used within EU Member State procurement processes.	Medium (1.5-5 years)	R: EC A: Municipality and Regional stakeholders responsible for public procurement C: Regional procurement platforms C: CE consultancies I: Supplier networks	Relevance Acceptance Credibility Ease Robustness

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
Development of standardised training for procurement officials	EC to fund regular training courses to be conducted with procurement officials on the latest GPP criteria and effective monitoring practices.	Medium (1.5-5 years	R: EC A: Municipality and Regional stakeholders responsible for public procurement C: Regional procurement platforms C: CE consultancies I: Supplier networks	Acceptance Ease Robustness

3. INDICATOR 2: SHARE OF PUBLIC PROCUREMENT NOTICES THAT STIPULATE SPECIFIC CIRCULAR ECONOMY ASPECTS

This indicator is used to measure the share of the value of public procurement notices that stipulate specific circular economy (CE) aspects.

As noted by the Ellen MacArthur Foundation (EMF), circular public procurement is a 'powerful tool that city governments can use to shape the transition towards a circular economy' (2023). By establishing clear CE criteria within public procurement notices, public authorities can influence change at the product, supplier and market level through the purchasing of circular products and services (ICLEI, 2018).

This indicator aligns with EU Green Public Procurement (GPP) criteria set within the framework of Strategic Public Procurement, together with Socially Responsible Public Procurement (SRPP) and Innovation Procurement, which provides clear, verifiable, justifiable and ambitious environmental criteria to enable sustainable public procurement. This reinforces key aspects of circularity through consideration of material origins, durability, recyclability and lifecycle assessments (EU Commission, 2024).

Following the adoption of the 2020 Circular Economy Action Plan (CEAP), the European Commission (EC) has proposed introducing minimum mandatory GPP criteria and targets in sectoral legislation, and to phase in compulsory reporting to monitor uptake. This indicator takes these ambitions one step further by encouraging cities and regions to explicitly monitor the performance and market acceptability of circular products and services within procurement.

There are several benefits to monitoring this indicator, for example:

- It is supportive of the CEAP's objective to reach a circular material use rate of 23.2% by 2030 by incentivising the integration of CE criteria within public procurement.

- Standardising how circular procurement is monitored helps promote the harmonisation of sustainable and circular public procurement practices at the municipal and regional level.

- It enables local and regional policymakers to benchmark their sustainable public procurement performance against peers at the national and European level. This provides insights into sustainable procurement policy effectiveness, further guiding targeted policy development.

- It encourages innovation within public procurement. It enables public procurers to engage suppliers on new uses for byproducts, thereby enhancing the competitiveness of industries fostering new technologies and business models.

3.1 KEY METHODOLOGY

3.1.1 Testing method

The system boundary for this indicator applied to the monitoring of public procurement notices stipulating specific CE aspects that have been published by one municipal administration (the Municipality of Lund, Sweden), and one regional government (the Government of Catalonia, Spain) in the time period: 1st January 2023 to 31st December 2023.

The region of Catalonia was selected due to their prior work in promoting sustainable public procurement practices. As a populous region (7.98 million[12]), with a significant economic output (292.5€ billion[13]) and an autonomous status, it means that it has some scope to set its own legislative agenda. Since 2005, this has led to environmental criteria being included within most framework agreements used by the Government of Catalonia, as well as the production of GPP guides for products or services that contain recommendations broadly supportive of circular procurement outcomes, such as focusing on product durability and the use of

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[12] Statista, "Population of the Spanish autonomous community of Catalonia in 2023, by age group". (Statista.com, 03/11/2024), https://www.statista.com/statistics/448882/population-of-catalonia-by-age-group/. Accessed: 09/04/2024

[13] Statista, "Gross domestic product (GDP) in Catalonia between 2003 and 2023". (Statista.com, 03/04/2024), https://www.statista.com/statistics/327097/gross-domestic-product-in-catalonia/. Accessed: 09/04/2024

recycled materials. However, these do not provide a comprehensive CE procurement framework. Nonetheless as the Circular Economy for Catalunya Roadmap (FRECC) 2030 has policy objectives to integrate circular procurement criteria in the government's strategic documents, it was assumed this case study may represent a suitable point of comparison with other cities and regions in the EU[14].

As a smaller city, the Municipality of Lund was expected to allow the research team to test the feasibility of monitoring this indicator on a smaller scale. Having set targets to embed circular and sustainable procurement practices in their Climate Neutral Lund 2030 strategy, published in January 2022, this would also provide insights into the rate at which these changes can be implemented at the local level (Lunds Kommun, 2022).

To test this indicator, the scope of study was restricted to monitoring public procurement notices that match the specific Common Procurement Vocabulary (CPV) codes listed in Table 9 below. These CPV-codes were selected to cover a broad spectrum of potential product categories and purchasing practices of the administrations targeted during this study.

Table 9: CPV-code categories included within this study

CPV-Code	Title
15000000-8	Food, beverages, tobacco and related products
18000000-9	Clothing, footwear, luggage articles and accessories
39000000-2	Furniture (incl. office furniture), furnishings, domestic appliances (excl. lighting) and cleaning products
44000000-0	Construction structures and materials; auxiliary products to construction (except electric apparatus)
45000000-7	Construction work
50000000-5	Repair and maintenance services
60000000-8	Transport services (excl. Waste transport)
71000000-8	Architectural, construction, engineering and inspection services
73000000-2	Research and development services and related consultancy services

To automate this process, the research team deployed a web-scraping tool, which used digital methods to extract data from online platforms/databases using digital software. This involves "fetching the data" where a webpage is downloaded, before data is "extracted", thereby allowing the webpage's contents to be searched, reformatted, and analysed in a relatively efficient manner. Data extracted for the testing of this indicator included each public procurement notice's expedient code (file identifiers), their associated CPV codes, and all PDF documents associated with each notice. These PDFs were then analysed to assess the presence of predetermined key terms associated with specific CE aspects. As this process required the use of downloadable PDF documents, public procurement notices without such documents on the platforms/databases were excluded. In the case of the Region of Catalonia, this applied to a very high proportion of notices classified as "Minor Contracts" (low value contracts) on the Platform for Public Procurement for Catalonia website.

The process was conducted in five stages (detailed further down below):

1. Defining key terms related to CE aspects in procurement.
2. Scraping procurement website.
3. Downloading relevant PDF documents.
4. Performing an automated PDF analysis.
5. Fuzzy matching and quality assurance.

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[14] Generalitat de Catalunya, "Full de Ruta de l'Economia Circular a Catalunya" (mediambient.gencat.cat, 2024) https://mediambient.gencat.cat/web/.content/home/actualitat/2024/docs/FRECC_Consell-Tecnic_.pdf. Accessed: 01/04/2024.

3.1.1.1 Definition of key terms related to CE aspects in procurement

Following the definition provided by the Ellen MacArthur Foundation (2023), circular public procurement is the process by which the public sector purchases products and services in accordance with the three principles of the CE:

- Eliminate waste and pollution.
- Circulate products and materials (at their highest value).
- Regenerate nature.

The principles of the CE can be applied to the purchase of various products and services, such as buildings, furniture, food and packaging, among others, and can be expanded to cover a wide range of impacts across a product's lifecycle. Neither case study region has produced a comprehensive CE framework for procurement. As such, for the purposes of this study, the research team adapted themes from the Circular Procurement Ambitions Chart developed by Circular Flanders (see Figure 1) to generate key terms in English, Catalan, and Swedish (Circular Flanders, 2024). This framework is often cited within circular procurement guidance documents produced within EU Member States, and was selected on the basis it could provide a standardised point of comparison between both case studies within the research. As to be discussed in section 3.2.2, this framework is one of several referenced by EU policymakers, and terminology may vary between regions and institutions. Nonetheless, in the absence of a clear definition of CE public procurement criteria, this framework was deemed suitable for testing the feasibility of monitoring this indicator. The key terms identified in this process are listed in Table 10 to Table 14 below.

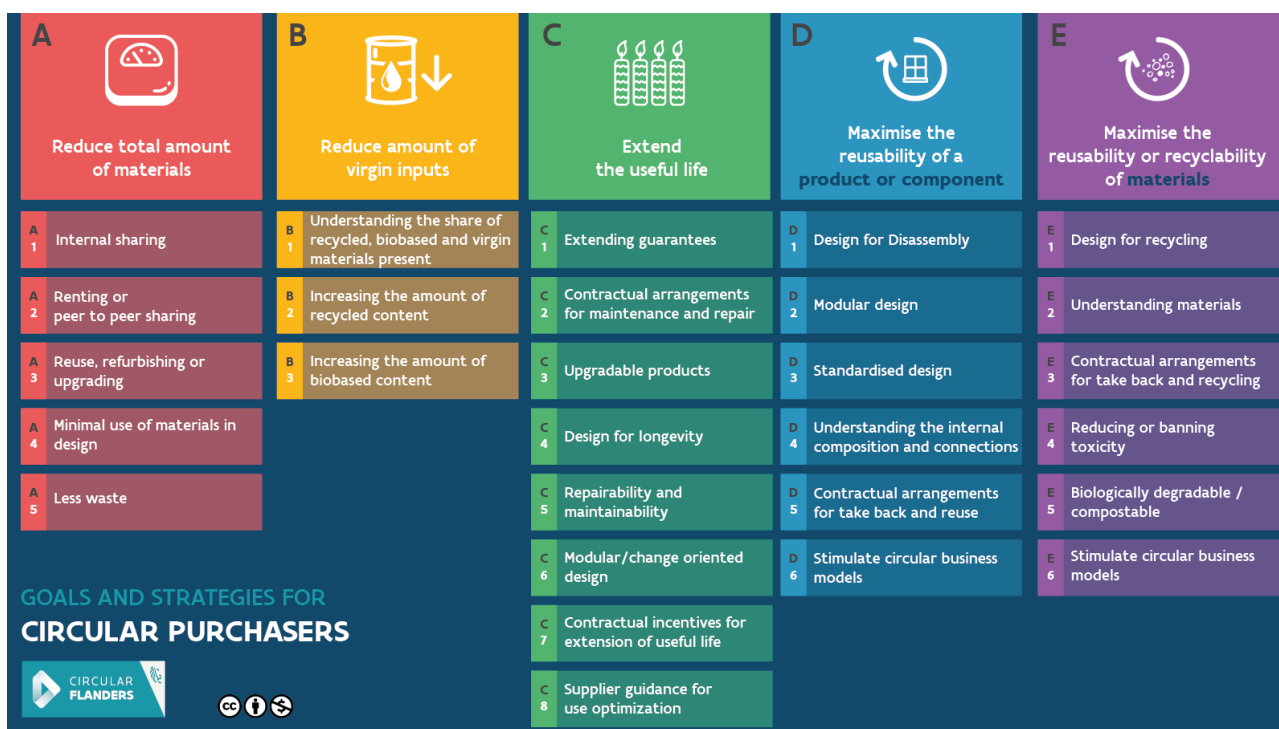**Figure 1: Circular Purchasers Ambitions Chart (Circular Flanders, 2024)**

Table 10: Key words associated with circular procurement ambitions to reduce the total amount of materials procured (Circular Flanders, 2024)

1	Circular Economy	Economia circular	Cirkulär ekonomi
A	Reduce total amount of materials	Reduir la quantitat total de materials	Begränsa den totala materialåtgången

1	Circular Economy	Economia circular	Cirkulär ekonomi
A2	Rent Renting	Lloguer Lloguer	Delad användning Dela Delning Hyra Uthyrning
	Lease Leasing	Arrendament Arrendament	Leasing
A3	Reuse Refurbish Upgrade	Reutilitzar Reformar Actualitza	Återanvänd Återtagning Uppgradera Uppgraderingsbara
A4	Minimal use of materials	Ús mínim de materials	Minimerad materialåtgång
	Minimise use of materials	Minimitzar l'ús de materials	Minimera materialåtgången
A5	Less waste	Menys residus	Mindre avfall
	Resource Efficiency	Eficiència dels recursos	Resurseffektivitet
	Reduce waste	Reduir els residus	Minska avfall
	Prevent waste	Prevenir els residus	Förebygg avfall
	Waste management plan	Pla de gestió de residus	Avfallshanteringsplan
	Waste reduction plan	Pla de reducció de residus	Avfallsminimeringsplan Avfallsminskningsplan

Table 11: Key words associated with circular procurement ambitions to reduce the amount of virgin inputs in procurement (Circular Flanders, 2024)

B	Reduce amount of virgin inputs	Reduir la quantitat d'inputs verges	Minska mängden jungfruliga råvaror
B1	Share of recycled materials	Quota de materials reciclats	Andelen återvunna material
	Share of recycled content	Part de contingut reciclat	Andelen återvunnet innehåll
	Share of biobased materials	Part de materials de base biològica	Andelen biobaserade råvaror
	Share of biobased content	Part de contingut de base biològica	Andelen biobaserat innehåll
B2	Recycled materials/content	Materials/contingut reciclats	Återvunnet material/innehåll
B3	Biobased materials/content	Materials/contingut de base biològica	Biobaserat material/innehåll

Table 12: Key words associated with circular procurement ambitions to extend the useful life of a product (Circular Flanders, 2024)

C	Extend the useful life	Allargar la vida útil	Ökad livslängd
C1	Extended guarantees	Ampliació de garanties	Förlängda garantier
C2	Agreements for Maintenance	Acords de Manteniment	Avtal om underhåll
	Agreements for Repair	Acords de reparació	Avtal om reparationer
	Maintenance service	Servei de manteniment	Underhåll
	Repair service	Servei de reparació	Reparation
C3	Upgradable product	Producte actualitzable	Uppgraderingsbar produkt
	Upgradability	Actualització	Möjlighet att uppgradera
C4	Design for longevity	Disseny per a la longevitat	Design för ökad livslängd
	Design for durability	Disseny per a la durabilitat	Design för hållbarhet
	Durability	Durabilitat	Hållbarhet
C5	Repairability	Reparabilitat	Möjlighet att reparera
	Maintainability	Mantenibilitat	Möjlighet att underhålla
C6	Modular design	Disseny modular	Modulär design
C7	Product life extension	Allargament de la vida útil del producte	Ökad livslängd för produkt
	Extension of useful life	Ampliació de la vida útil	Förlängd livslängd
	Extend functional lifetime	Ampliar la vida útil functional	Förlängd funktionell livslängd
C8	Supplier guidance for use optimisation	Orientació del proveïdor per a l'optimització d'ús	Vägledning från tillverjare för optimal användning
	Guidance for product maintenance	Orientació per al manteniment del producte	Vägledning för produktunderhåll

Table 13: Key words associated with circular procurement ambitions to maximise the resuability of a product or component (Circular Flanders, 2024)

D	Maximise the reusability of a product or component	Maximitzar la reutilització d'un producte o component	Maximera möjligheten för återanvändning av en produkt eller komponent
D1	Design for disassembly	Disseny per al desmuntatge	Design för demontering
D2	Modular design	Disseny modular	Modulär design
D3	Standardised design	Disseny estandarditzat	Standardiserad design
D5	Take back scheme/system	Esquema/sistema de recuperació	Återtagningssystem
	Take back and reuse scheme/system	Esquema/sistema de recuperació i reutilització	Återanvändningssystem

D	Maximise the reusability of a product or component	Maximitzar la reutilització d'un producte o component	Maximera möjligheten för återanvändning av en produkt eller komponent
D6	Circular business models	Models de negoci circulars	Cirkulära affärsmodeller
	Circular economy business models	Models de negoci d'economia circular	ibid

Table 14: Key words associated with circular procurement ambitions to maximise the reusability or recyclability of materials (Circular Flanders, 2024)

E	Maximise the reusability of materials	Maximitzar la reutilització dels materials	Maximera möjligheter till återanvändning och återvinning av material
E1	Design for recycling	Disseny per al reciclatge	Design för återvinning
E2	Understanding materials	Comprensió dels materials	Förstå material
E3	Contractual agreements for take back and recycling	Acords contractuals de recuperació i reciclatge	Avtal om återintag och återvinning
	Take back and recycling service	Servei de recuperació i reciclatge	Tjänst för återvinning och återintag
	Collection for recycling	Recollida per al reciclatge	Insamling för återvinning
E4	Reduce toxicity	Reduir la toxicitat	begränsning eller förbud av farliga ämnen
	Restricted chemicals	Substàncies químiques restringides	
E5	Biologically degradable	Degradable biològicament	Biologiskt nedbrytbara
	Biologically compostable	Biològicament compostable	Biologiskt komposterbara
	Biodegradable	Biodegradable	ibid
	Compostable	Compostable	ibid

3.1.1.2   Scraping procurement website

The web-scraping process was initiated by opening the target procurement website and navigating through it to extract and download procurement notices based on the predefined CPV code. This process is detailed in the script (a web-scraping tool) provided in Appendix 5.6. This step downloaded all relevant data associated with notices for the CPV codes listed above (Table 9), including publication date and value.

This process followed the following key steps:

- **Setup:** Selenium WebDriver (a browser plug-in) was used to automate browser interactions, with ChromeDriver (an open-source tool for testing webapps) configured to handle downloads.
- **Accept Cookies/T&Cs:** The script navigated to the search page of the procurement website and programmatically accepted cookies or terms and conditions to proceed.
- **CPV Codes Iteration:** The script iterated over a list of CPV codes, performing searches to gather procurement notices related to these codes.

- **Data Extraction:** For each CPV code, the script scraped relevant data from the search results, including expedient codes, tender procedures, and links to detailed notice pages.
- **Exclusion of Minor Contracts:** Notices tagged as 'minor contracts' by a public procurement platform were excluded from the process due to the lack of downloadable PDF documents necessary for key term matching.

3.1.1.3   Downloading relevant PDF documents

Following the initial scraping, all the PDF documents available associated with each non-excluded procurement notice were downloaded. This included downloading the listed technical specifications, justifications, contracts, and evidence associated with each identified procurement notice's expedient code.

This process followed the following key steps:

- **Iteration Over Notices:** The script iterated over the previously scraped data, visiting each notice's detail page.
- **PDF Links Identification:** It identified links to downloadable PDF documents based on the document type (e.g., Technical specification documents; "Plec de prescripcions tècniques" in Catalan).
- **PDF Download:** Relevant PDF documents were downloaded and saved in a structured directory based on CPV codes and expedient codes.

3.1.1.4   Performing an automated PDF analysis

Another script provided in Appendix 5.6 analysed the downloaded PDF documents searching for the key terms, extracting specific information to quantify the results of this indicator, such as the frequency of key term use, and their specific location in supporting documentation, which enables further quality assurance processes.

3.1.1.5   Fuzzy matching and quality assurance

Fuzzy matching, which is a web-scraping technique to review strings of text for similarities, identifying similar, but not identical elements in data, was applied where exact matches between data fields were not feasible due to variations in naming conventions or typos. This approach enhanced data matching accuracy beyond simple string comparisons.

This process involved the following key steps:

- A matching criterion of 95% was set to ensure that as close a match to the key terms was made as possible, while allowing for variation.
- This data was extracted into an MS Excel document, where pivot tables were used to summarise all expedient codes containing key term matches within the relevant public procurement notice documentation, the specific key terms matched, alongside the frequency of matches.
- It was assumed that the fewer total number of key term matches there were, the less likely it was that these procurement notices contained true matches with CE aspects, potentially leading to "false positives" (where the automated tool detected the presence of key terms in supporting documents of notices with no CE aspects). To mitigate this risk, a threshold for the level of confidence in the accuracy of the automated process was established, as described below:
  - o If notices contained less than a total of five key term matches, it was assumed that there was a low level of confidence in the accuracy of the automated check, and therefore the supporting documents were manually checked for the presence of CE aspects.
  - o If notices contained a total of five or more key terms matches, it was assumed that there was a high level of confidence in the accuracy of the automated check, and therefore the supporting documents were not manually checked for the presence of CE aspects.
- The level of the threshold was defined on the basis of feasibility within the timeframe and budget of this project as manual checks are time consuming. As such, future research wishing to apply the same methodology, may wish to set a higher threshold for study to improve further the accuracy of the results.

3.1.1.6   Output from this testing method

All the data from each of these steps were combined within an MS Excel a spreadsheet for further analysis, which allowed the research team to calculate the results for this indicator.

3.1.2   Data collection method

This indicator has the following data requirements:

- Pre-defined CE key terms.
- The total number of public procurement notices published in the period January to December 2023 with the CPV-codes that are listed in Table 9.
- The total number of public procurement notices published in the period January to December 2023 with the CPV-codes that are listed in Table 9 that have CE aspects.
- The value (€) of each public procurement notice published in the period January to December 2023 with the CPV-codes that are listed in Table 9.
- The value (€) of each public procurement notice published in the period January to December 2023 with the CPV-codes that are listed in Table 9 that have CE aspects.

To collect this data, the research team carried out desk-based search and stakeholder engagement to identify data sources and relevant procurement officials in both Lund and Catalonia, ensure access to procurement data and sense-check findings once data collection was complete.

3.1.2.1   Desk-based search

Desk-based search was conducted to identify public procurement platforms used by each case study city and region and relevant stakeholders.

To identify relevant stakeholders, the research team carried out desk-based review of public procurement policy statements, reports, briefing notes, conference itineraries relevant to each city/region's sustainable procurement policies, as well as regional procurement agencies. Once a stakeholder had been identified, these were evaluated for relevance according to area of responsibility and how up to date the data source was.

Initial search terms used (translated into official language of region using DeepL for Swedish and Spanish, and Google Translate for Catalan):

- ("Green public procurement" OR "Sustainable procurement" OR "Circular procurement") AND ("Department" OR "agency") AND ("City" OR "Region")

Stakeholder engagement

The research team conducted two 60-minute interviews, one with relevant stakeholders from the Municipality of Lund and one with relevant stakeholders of the Government of Catalonia's public procurement services.

The interviews had three purposes:

- To ensure that the research team had identified the correct data sources.
- To request quantitative data relevant to this indicator.
- To understand the perceived challenges and long-term aspirations of each city/region in relation to measuring this indicator.

In the case of the Government of Catalonia, key stakeholders interviewed included representatives from the following departments of the Government of Catalonia's public procurement services: Public Procurement, the Regulation and Supervision of Public Procurement, the Public Procurement Consultative Board of Catalonia and Centralised Purchasing. During this interview, the research team confirmed that the terms defined were accurate and relevant, and that the most relevant public procurement platform that should be used was the Plataforma de Serveis de Contració Publica (referred to throughout as the Public Procurement Platform of Catalonia)[15].

Following the interview, the research team developed the web-scraping tool, downloaded all relevant metadata for the period of January 2023 to December 2023 from the Public Procurement Services of Catalonia platform and conducted the testing of this indicator.

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[15] Paltaforma de Serveis de Contractació Pública, "Public procurement services of Catalonia Platform use data" (https://contractaciopublica.cat/en/inici, 2024). Plataforma de Serveis de Contractació Pública (contractaciopublica.cat). Accessed: 01/04/2024

In the case of the Municipality of Lund, key stakeholders interviewed included representatives of the Municipality of Lund's Public Procurement department. During the interview, key terms were confirmed as relevant, however, the municipality were not able to provide access to a local public platform where relevant metadata could be downloaded. This was because the municipality uses the Adda platform, a procurement service operated and used by the majority of Sweden's municipalities, for the management of their procurement services[16]. The research team contacted Adda to request access to data specific to the Municipality of Lund. However, due to commercial sensitivities, they were not able to provide access to the research team, nor share details on which contracting authority had procured goods from specific frameworks. To mitigate this data gap, the research team distributed a MS Forms survey to public sector organisations within the legal boundaries of Lund to collect the data needed. The survey questions are listed in Appendix 5.2.1.

3.1.3 Calculations

To calculate the share of the value of public procurement notices stipulating specific CE aspects, the following formula was used:

$$\text{CR4: Share of public procurement notices that stipulate specific CE aspects} = \frac{\text{Total value of public procurement notices that stipulate specific CE aspects}}{\text{Total value of public procurement notices}}$$

3.1.4 Timeline

This process took place in a fourteen-week period between December 2023 and March 2024, as detailed in the Table 15 below.

Table 15. Gantt chart

Week Commencing	01-Jan	08-Jan	15-Jan	22-Jan	29-Jan	05-Feb	12-Feb	19-Feb	26-Feb	04-Mar	11-Mar	18-Mar	25-Mar	01-Apr
Review Green Public Procurement Action Plans	■													
Research on data sources	■	■	■	■	■									
Engage stakeholders		■	■	■	■					■				
Public procurement surveys							■	■	■					
Development & application of Web-scraping tool.								■	■	■				
Analysis and write up											■	■		
Review period							■ (dark)			■ (dark)			■ (dark)	
Key deliverables											■ (orange)		■ (orange)	

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[16] Adda Inköpscentral, "Om oss" (https://www.adda.se, 2024). https://www.adda.se/om-oss/about-adda/. Accessed: 01/04/2024

3.1.5 Data gaps and mitigation

Table 1616 below summarises the data gaps and mitigations associated with testing this indicator.

Table 16. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	The data required to assess this indicator is not being monitored in a systematic or robust manner.	• The research team used a web-scraping tool to identify the presence of specific CE terms used within tender documents listed on digital public procurement databases.	High
2	At the national level, the Open Tender and Tenders Electronic Daily (TED) databases register all tenders above EU thresholds, including whether environmental considerations have been considered. However, because of many missing values and the absence of a standard format, the numbers remain estimates.	• Where limited information was found online, the research team engaged with public procurers from the relevant municipalities and regions to verify findings and sources of information. • Development and application of web-scraping tool to automate quantification of tenders containing CE aspects as listed on government public procurement data bases.	High
3	No access to Lund public procurement database.	• Attempts to conduct stakeholder surveys of public sector organisations in the city were made to request estimations on the number of public procurement notices containing CE aspects. • 61 organisations were emailed however, no responses were received. Therefore, it was not possible to quantify this indicator for the city of Lund.	Low
4	Terminology for CE aspects may vary across languages.	• The research team used translation software to translate key terms from English to Swedish and Catalan. • As the Government of Catalonia has published GPP guidance documents in Catalan, which contain recommendations for CE aspects, such as for product durability and the use of recycled materials, the terms were cross referenced with the translated key terms in Tables 9 to 13 to ensure consistency between them.	Medium

3.1.6   Quality review of analysis

To ensure robust and high-quality results, Ricardo conducted the following data validation and quality control procedures:

- Prior to work beginning, the Project Director reviewed the proposed research methodology and ensure that the data collection plan is fit for purpose. Once the research team addressed any comments from the review process, they proceeded to the data collection phase.

- The research team built an MS Excel database to record relevant procurement data for publicly purchased products following CE aspects for each case study city. This was reviewed by the Project Director prior to analysis being conducted.

- The research team presented semi-structured interview guides and a list of stakeholders identified for interview to the Project Director for review prior to interviews being carried out.

- The Project Director held responsibility for the quality of the final case study output. During the review period, the Project Director and senior subject matter experts were involved in judging the quality of the output and suggesting ways to improve.

3.1.6.1   Results of the quality review of the automated process

The manual review of the automated process resulted in 32 of 46 tenders with fewer than five matches (defined as 'weak') being checked and discarded from the list. These exclusions were expected as only the matches defined as 'weak' were manually checked. The reasons for these were summarised in the Table 18 below.

Table 17: Summary of procurement notices excluded from the analysis of public procurement notices for the Government of Catalonia

Reasons for expedient exclusion	Number	Share of excluded expedients
The expedient does not contain CE aspects	20	62.50%
Key word was not found in the expedient	7	21.88%
Could not find the expedient	5	15.63%
Total	**32**	**100%**

These results demonstrates that while the use of similar web-scraping tools are able to save significant time and resources, it is also necessary to factor resourcing for manual quality assurance checks for tenders with a low frequency of key term matches.

3.2   KEY ANALYSIS RESULTS

3.2.1   Analysis

Table 18 below presents the share of the total value of public procurement notices containing CE aspects (in €) for the Government of Catalonia for the period January 2023 to December 2023. Please see Appendix 5.4 for further details on the results.

Table 18: Summary of key results for the share of public procurement notices stipulating CE aspects

Results of web-scraping analysis	Government of Catalonia
Total value of public procurement notices assessed	589,647,619.21 €
Total value of public procurement notices stipulating CE aspects	48,983,356.41 €
Share of the total value of public procurement notices containing CE aspects (in €)	**8.31%**

Table 19 below present the analysis of public procurement notices for each product category in the Region of Catalonia for the period January 2023 to December 2023. Of the 6,645 public procurement notices analysed, 163 were found to contain specific CE aspects, with a total value of €48,983,356.41. These notices represented 7.88% of the total value of all notices analysed during the study.

The analysis showed that the highest performing product category was found to be for Food and beverage products (CPV code 15000000-8), where ten procurement notices were found to contain CE aspects, which amounted to 20.63% of the total value of notices for the year 2023. The majority of the CE aspects identified related to waste minimisation and prevention strategies, alongside stipulations specifically targeting packaging, such as the use of recyclable and compostable materials.

Similarly, for the next highest performing product category, Transport services (CPV code 60000000-8), nine procurement notices containing CE aspects represented 18.14% of the total value of notices in this category. In this category key CE aspects identified through web-scraping include the minimisation and management of waste, as well as service design aspects, such as, repair, maintenance and leasing services.

For Clothing, footwear, luggage articles and accessories (CPV 18000000-9), public procurement notices stipulating CE aspects were found to represent 16.49% of the total value for this product category, with key terms being associated with requirements for product durability and the minimisation of waste, both during the production and distribution of the services provided.

In relation to the built environment, the analysis shows that for Construction structures and materials (CPV 44000000-0), the value of notices stipulating CE aspects represented 9.77% of the total value for this product category. This represents a slightly higher proportion when compared to the share of public notices stipulating CE aspects for Construction works (CPV 45000000-7), which represented 7.08% of the total value of notices in this category. Meanwhile, for Architectural, construction, engineering and inspection services (CPV 71000000-8), notices stipulating CE aspects accounted for just 11.08% of the total value of procurement notices within this category.

Within the category for Furniture, furnishings, domestic appliances and cleaning products (CPV 39000000-2), public procurement notices stipulating CE aspects were found to have a share of 7.56% of the total value of notices in this category, with key terms being associated for modular design, design for durability and recyclability.

For Research and development services and related consultancy services (CPV 73000000-2), the share of the procurement notices stipulating CE aspects represented 4.78% of the notices for the period of study.

Finally, the lowest performing product category was found to be for Repair and maintenance services (CPV code 50000000-5). Here, notices stipulating CE aspects represented only 4.07% of the total value of notices listed, despite a relatively high number of notices (32) stipulating CE aspects related to repair and maintenance, as well as the minimisation and management of waste and materials.

Table 19: Analysis of the total value of expedients containing specific CE aspects

CPV-Code	15000000-8	18000000-9	39000000-2	44000000-0	45000000-7	50000000-5	60000000-8	71000000-8	73000000-2	Total
Total expedients	62,188,721.13 €	4,010,745.12 €	4,344,367.85 €	1,873,491.72 €	316,887,335.80 €	149,338,035.65 €	3,619,155.71 €	69,356,202.67 €	14,262,219.36 €	**625,880,275.01 €**
Total minor contracts	900,438.84 €	294,058.77 €	1,949,323.95 €	922,393.00 €	15,934,915.40 €	12,568,442.05 €	824,724.88 €	2,269,051.82 €	569,307.09 €	**36,232,655.80 €**
Expedients for analysis	61,288,282.29 €	3,716,686.35 €	2,395,043.90 €	951,098.72 €	300,952,420.40 €	136,769,593.60 €	2,794,430.83 €	67,087,150.85 €	13,692,912.27 €	**589,647,619.21 €**
Expedients meeting CE aspects	12,641,453.66 €	612,737.87 €	181,113.92 €	92,959.46 €	21,299,604.78 €	5,560,924.66 €	506,895.00 €	7,433,596.15 €	654,070.91 €	**48,983,356.41 €**
Share of expedients meeting CE aspects (by value)	**20.63%**	**16.49%**	**7.56%**	**9.77%**	**7.08%**	**4.07%**	**18.14%**	**11.08%**	**4.78%**	**8.31%**

3.2.2 Limitations

3.2.2.1 Data availability and completeness

In the case of the Government of Catalonia, while the research team was able to identify a number of tenders listed on the Public Procurement Platform of Catalonia, there are some limitations and uncertainties associated with this data.

- The analysis was restricted to assessing only the tenders listed on this platform that had uploaded supporting documents in a PDF format. While this did enable the research team to efficiently assess the presence of key terms within the majority of the listed tender's technical specifications, the research team had to exclude a significant number of "minor" contracts from the analysis, as they had been listed on the platform without any form of supporting evidence that could be analysed for CE aspects. On average these represent over 71% of the total number of listed procurement notices per CPV code. While in the majority of cases these represented a relatively insignificant share of total value per CPV code (less than 1.5% of total value per CPV code), for CPV-codes 39000000-2 (Furniture, furnishings, domestic appliances and cleaning products) and 44000000-0 (Construction structures and materials), these respectively represent 44.87% and 49.23% of the total value per CPV code. As such, these minor contracts represent a relatively significant proportion of public procurement activity which currently cannot be monitored using automated web-scraping tools. Please see Appendix 5.4 for further information on this data.

- To ensure the research was feasible within the time allocated, the scope of the research was restricted to a limited range of CPV codes, and excluded other key product categories such as Electrical machinery (CPV code 31000000-6) and Medical Equipment (CPV code 33000000-0). As such, the results are not fully representative of all the public procurement activities in this region and may result in underreporting for this indicator.

- In addition, the government stakeholders interviewed noted the potential of inconsistencies in how the CPV codes used to categorise each notice had been uploaded to the platform. This is due to the fact that each municipality within the region was responsible for uploading data to the platform and it was challenging to standardise each municipality's practices and eliminate human error. It was recognised that more training and guidance may be needed to reduce this in the future. Nonetheless, no mitigation activity was carried out as this risk was deemed not to be significant.

- Finally, due to availability issues, it was not possible to conduct a follow-up interview to sense-check findings with representatives once analysis had been completed, reducing the opportunity to either identify potential anomalies in the data assessed or the practicality of stakeholders within the administration of using this method in their own processes.

To mitigate these issues, the research team conducted an email survey of 13 administrations in the City of Barcelona and a further 11 municipalities with a population above 72,500 inhabitants in the region of Catalonia to request estimations on the proportion of public procurement notices that contained CE aspects. This resulted in no responses within the data collection period. Nonetheless, it was thought that the research team was able to analyse the listed public procurement notices with a reasonable level of confidence.

In the case of the Municipality of Lund, efforts to test this indicator produced no results due to the way in which procurement practices in Sweden are managed. Indeed, commercial contract information can only be accessed via the intermunicipal procurement platform, Adda, which the research team could not get access to or to the data it contains due to commercial sensitivities. Attempts to mitigate this through the use of a survey targeting stakeholders in 61 public sector organisations in the city of Lund also resulted in no response within the data collection period. Therefore, this indicator could not be measured for that region and the analysis could not be compared with results from other EU Member States.

Taking these two cases into account, future monitoring efforts should also consider limitations imposed by external factors on the availability of data. The impact of the current economic climate, alongside the impact of public budgets, can influence the extent to which CE criteria are prioritised or implemented by public administrations, both in terms of spend on CE compliant products and services, as well as in terms of resources invested in monitoring their presence in public procurement.

Finally, it is important to consider the limitations of web-scraping more broadly as an approach to monitoring this data. As noted in Section 3.1.1, web-scraping scripts are developed to match the specific architecture/layouts of the websites they are designed to extract data from. As websites often change their layouts, this can require web-scraping scripts to be frequently updated to avoid them breaking. In addition, this might not be easily scalable across different regions or products due to varied data availability and technology, as well as require a fairly high level of technical expertise within reporting administrations that might not be readily available. Even with web-scraping, there may also be gaps in data coverage due to differences in how procurement notices are published or archived. This methodology is therefore limited by a dependency on published data. As indicated by the exclusion of minor contracts in this study, this may result in incomplete datasets as all relevant transactions may not be publicly disclosed or documented.

3.2.2.2   Scope of study

Analysis of these results indicate a need to differentiate between the total number of notices stipulating CE aspects and their value. Focusing on the value of these procurement notices, CE aspects have been identified in 20.63% the Food, beverages, tobacco and related products notices (CPV 15000000-8) and 16.49% of Clothing, footwear, luggage articles and accessories notices (CPV 18000000-9). However, a focus on the number of public notices stipulating CE aspects produces markedly different results, where the proportion of the number of Food, beverages, tobacco and related products notices containing CE aspects decreases to 14.29% and the proportion of the number of Clothing, footwear, luggage articles and accessories notices increases to 26.67%. Similarly, in relation to Furniture products (CPV 39000000-2) while only 0.36% of the total number of notices stipulate CE aspects, these notices represent over 7.56% of the total value for these notices. Full analysis of this data can be found in Appendix 5.4.

These variations may result in different policy responses for each product category. While the share of the total value of procurement notices containing CE aspects provides a useful indication of the scale of circular procurement at the regional level, they seem to be dominated by a smaller number of high value contracts. As such, administrations should be encouraged to incentivise the uptake of circular practices in lower value notices, which may potentially be serviced by small to medium sized businesses.

3.2.2.3   Data quality

To mitigate the risk of false positives (notices wrongly identified by the automated process as having CE aspects), a quality assurance methodology was developed using a threshold for the level of confidence in the automated process. This level was set as follows: any notice that had a count of less than five key term matches within the supporting documents were deemed to have a potentially "weak" relationship to CE aspects. This threshold was defined on the basis of feasibility within the timeframe and budget of this project as manual checks are time consuming and therefore, only a small number of notices identified were reviewed.

As a result, 24% of notices containing key term matches were manually reviewed. While this represents a significant proportion of the overall results, given the novelty of this approach, future research may seek to set a higher threshold to remove any remaining erroneous results.

3.2.2.4   Definition of key terms

There is limited consensus on what criteria can be included within CE procurement. While the use of the framework developed by Circular Flanders allowed the research team to adapt high level CE criteria across a range of aspects, these are not specific to particular product categories, where circularity might be applied in different ways. For example, while the criteria used in this study address different stages of a product or service's lifecycle, they do not indicate the extent to which circularity has been comprehensively embedded within the procurement process. In other words, it is possible that a tender may contain a high frequency of key terms associated with product life-extension processes (e.g. repair, refurbishment, and product as a service), without full consideration of the full lifecycle impacts associated with material selection or the end-of-life management. As a result, this may draw into question the environmental benefits of these public procurement notices, and the extent to which these can be considered truly "circular".

In addition, it is acknowledged that other countries may have different views for what constitutes circularity within their contexts. Indeed, the Circular Procurement for Cities framework, published by the EMF, underlines these factors by stating "Public procurement processes differ from one city to another and therefore this guide

is not a one-size-fits-all solution. Instead, it provides an overarching framework that should be adapted to your local context and the realities of your city" (Ellen MacArthur Foundation, 2023).

As such, the use of terminology adapted from the Circular Flandres framework may have potentially contributed to false negatives, whereby notices containing CE aspects that were not identified by the automated web-scraping tool are not counted. This risk is impossible to mitigate without developing a more comprehensive, standardised list of commonly accepted CE terms and aspects.

3.2.3   Performance

Table 20 below compares the RACER score allocated to the original indicator during Task 4 against the final indicator after the Task 5 testing process. During Task 4, the original indicator was allocated a score of 12 against the RACER evaluation process. Following testing of the feasibility and practicality of measuring this indicator in Task 5, the indicator was allocated a score of 10, for the reasons summarised below:

- **Relevance**: This refers to whether the indicator is closely linked to the objectives to be researched. From analysis of the web-scraping results for Catalonia, there was evidence that it was possible to monitor the share of public procurement notices containing requirements for CE aspects, such as recycled content, EU ecolabels, and design for durability, and therefore alignment with EU policy objectives. As such, the score of "Good" (3) remained unchanged as it was assessed to be fully aligned with EU policy objectives.

- **Acceptability**: This refers to whether the indicator is perceived to be of value to, and used by key stakeholders, such as procurement stakeholders within local and regional administrations. Through stakeholder engagement it was noted that the benefits of monitoring this indicator were clear and stakeholders reported interest in understanding how this could be measured in the future. At the same time, they noted that current challenges in relation to collecting data remained a significant barrier. As such, the score remained as "Neutral" (2) following testing.

- **Credibility**: This refers to whether the indicator is transparent, trustworthy and easy to interpret. While this indicator was easy to understand and to communicate to stakeholders, it was found that there was no easily applicable methodology that could be adopted by municipalities. This was due to the clear differences in the way in which local and regional administrations manage public procurement. While on the one hand, web-scraping greatly improved the way in which data can be collected, this would need to be enabled by cities and regions standardising their procurement systems to allow monitoring to be rolled out across cities and regions across EU Member States. As such, scoring for Credibility has been downgraded to "Neutral" (2).

- **Ease**: This refers to the easiness of measuring and monitoring the indicator. The score was downgraded to "Poor" (1). While the use of the web-scraping tool allowed the research team to download and assess data from the Government of Catalonia's public procurement platform with relative ease, this process was not possible in the case of Lund due to the use of the Adda platform which did not allow access to the data needed to assess this indicator.

- **Robustness**: This refers to whether data assessed is biased and whether it comprehensively assesses circularity. The score remained unchanged as "Neutral" (2). Despite the noted challenges in collecting data for reporting, this remained a one-dimensional indicator with a consistent methodology.

Table 20. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	3	2	3	2	2	12
After Task 5 (following testing)	3	2	2	1	2	10

3.3 CHALLENGES AND LESSONS LEARNED

3.3.1 Challenges

3.3.1.1 Data availability

This was a challenging indicator to monitor as there is currently no legislative requirement for cities or regions to publicly disclose the number of public procurement notices that stipulate CE aspects. As such, neither the Municipality of Lund nor the Government of Catalonia had access to comparable data to monitor this indicator.

The representatives of the Government of Catalonia's procurement departments interviewed noted that while this indicator aligns with policy objectives within their Circular Economy for Catalunya Roadmap (FRECC) 2030, this may be challenging to implement (Generalitat de Catalunya, 2024). While the government has developed GPP guidelines for procurement, these are not mandatory nor are they explicitly linked to CE outcomes. There is also no monitoring of whether or how municipalities within the region are seeking to apply due to challenges in coordinating such efforts as the regional level. Please note that the Government of Catalonia monitors the presence and value of "environmental clauses" in public procurement contracts, but these are not defined by product category or type of clause[17]. Following stakeholder engagement, it was found that this data would not be a suitable proxy for this indicator.

In the case of Lund, municipality representatives noted that the use of a web-scraping tool might not be feasible for the monitoring of CE aspects in procurement notices. While the Municipality would have access to some public procurement notices (for example the purchasing of uniforms for street cleaners and maintenance workers), the majority of public sector procurement activities are conducted via the Adda procurement platform and issues surrounding data access was perceived as a challenge.

Through email correspondence with a representative of the Adda procurement platform, it was noted that while they offer workwear framework agreements that contain specific sustainability requirements aligned with CE aspects (for example in terms of durability), they currently do not monitor whether the municipalities/regions procuring through the framework agreement have chosen to purchase from suppliers that meet these criteria. In addition, the representative noted that it was not possible to release information about which contracting authorities have made contracts through the frameworks they provide due to commercial sensitivities.

From this, it is anticipated that the accessibility of procurement databases will remain a persistent challenge across EU Member States due to a lack of standardisation of procurement practices at the municipal, regional, and state-wide level. In particular, the lack of standardised data formats across different procurement platforms will likely complicate data aggregation and analysis. To mitigate these limitations in the future, greater coordination between public and private procurement databases will be required to ensure greater availability of data.

3.3.1.2 Data quality

To mitigate any risks of false positives, a quality assurance (QA) methodology was developed to manually check any public procurement notice that fell below the confidence threshold of five key term matches. While this allowed the research team to conduct QA checks on 46 public procurement notices (24% of total results), future research may seek to develop a more robust QA methodology and set a higher threshold for manual checks.

3.3.1.3 Definition of key CE aspects

Given the potential variation in the way circular procurement concepts are defined and applied across EU Member States, noted in Section 3.2.2, it may be challenging for EU policymakers to ensure administrations take a consistent approach to monitoring this indicator. Without a standardised, critically reviewed, list of key CE aspects that should be monitored, there is a potential risk of bias or loosely defined CE criteria negatively influencing how this data is reported. In addition, different regions and Member States might have varying regulatory standards and requirements for public procurement, that would make it more it difficult to apply a uniform approach to integrating and monitoring CE aspects. This might result in a disparity between

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[17] Generalitat de Catalunya, "Contratació pública: Clausulas ambientales" (Contratacio.gencat.cat, 2023) https://contractacio.gencat.cat/ca/difusio/publicacions/indicadors/grafics/clausules-ambientals-en/. Accessed: 01/04/2024.

administrations that apply more stringent criteria for assessment and administration which apply more loosely defined criteria, thereby potentially undermining the credibility of results generated.

3.3.1.4   Stakeholder engagement

It is understood that stakeholders may have limited time and resources to contribute to future research and monitoring efforts, which can affect the quality and completeness of the information gathered. Nonetheless, their input is an important factor in mitigating issues surrounding data availability and quality. Stakeholder engagement should therefore be prioritised in future indicator development.

3.3.2   Lessons learned

3.3.2.1   Automated data collection process

In the case of the region of Catalonia, the application of a web-scraping tool greatly facilitated the ease with which the indicator was monitored, and the results analysed. The "modular" functionality of the tool allowed the research team to take an iterative approach to organising the metadata downloaded, refining key search criteria, and identifying results where a "weak" relationship to key CE aspects may exist. This process greatly improved the efficiency with which research can be carried out, however, as demonstrated by the number of exclusions, it does not negate the need for manual QA checks on the results generated.

While this approach is replicable, it should be noted that each web-scraping tool is essentially bespoke as they are designed to navigate the architecture of specific websites or databases, and it is not possible to reapply these tools between websites or databases. As such, if this method is applied in future assessments, then future research teams will need to designate time in designing individual web-scraping tools per database. If research teams wished to set a higher confidence threshold to remove erroneous results, this will also need to be factored into how time is budgeted for the study. In the case of Catalonia, the research team benefited from the fact that procurement notices were publicly listed on a platform that was free and open to access. In the case of Lund, this was not possible, as access to the Adda platform was restricted due to commercial sensitivities.

Therefore, future research teams wishing to test the feasibility of using web-scraping as a method to monitor this indicator will need to follow one of two approaches, either:

- Identify local and regional administrations that operate publicly accessible procurement platforms, and contain tender specifications and/or supporting evidence relevant to the indicator being assessed. For example, during initial desk-based search it was found that several regional and national administrations operate publicly accessible procurement platforms similar to the Catalonian Public Procurement Platform. These include Nantes Metropole,[18] the Spanish government and other regional administrations in Spain[19].

- Alternatively, research teams may reach out to the operators of restricted procurement platforms, such as Adda, to gauge interest in participating in similar research in the future.

In addition, future research may seek to analyse the presence of specific CE aspects within public notices, such as requirements for recycled content, packaging reuse schemes or repair services. This would increase the granularity of results generated and act as a market signal to encourage suppliers to provide these services.

3.3.2.2   Stakeholder engagement

The research team sought to mitigate data gaps associated with both areas under study through the use of stakeholder surveys to request estimations on the presence of CE aspects in their public procurement activities. This was a resource and time-intensive approach, and generated no results during the data collection period. Therefore, future mitigation efforts should seek to factor in a longer stakeholder engagement period.

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[18]   Nantes Metropole, "MARCHES PUBLICS DEMATERIALISES" (marchespublics.nantesmetropole.fr, 2024). https://marchespublics.nantesmetropole.fr/entreprise. Accessed 01/04/2024

[19]   Gobierno de Espana, "Plataforma de Contratación del sector Público" (contrataciondelsectorpublico.gob.es/, 2024) https://contrataciondelsectorpublico.gob.es/wps/portal/licitaciones. Accessed: 01/04/2024

3.3.2.3   *Measuring impact*

The research indicates the need to measure both the number and share of public procurement notices stipulating CE aspects. As noted in Section 3.2.2, a small number of high value procurement notices may have a distorting effect on the results for this indicator and, by extension, how circular procurement practices are monitored and reported on within each city and/or region. The initial findings suggest that policymakers may benefit from analysing both factors (number of notices and value) together. This would provide a more holistic understanding of the scale (number) and impact (value) of notices stipulating CE aspects within each city.

Finally, as noted in Section 3.2.2, it was not possible to analyse the presence of CE aspects within "minor" notices for the region of Catalonia. Minor procurement activities tend to be published for low value contracts awarded to suppliers from local small and medium sized enterprises (SME), where for expediency administrations utilise framework agreements and automated processes to efficiently award contracts. In the case of Catalonia, it appears that supporting documents (e.g. tenders, technical specifications, awarding criteria) for these minor contracts have not been uploaded to the region's public procurement platform. Given the streamlined nature of minor procurement process, it is likely that this might be replicated in other regions.

3.4   CONCLUSIONS AND RECOMMENDATIONS

It is recommended that this indicator is considered for further development, with significant work required to facilitate its progress.

Public procurement remains one of the most powerful tools that local and regional administrations have at their disposal to accelerate the transition to a CE. By stipulating CE aspects within public procurement notices, cities and regions are able to stimulate sustainable innovation and increase demand for circular product and service offerings. By requiring local and regional administrations to report on the share of procurement notices containing CE requirements, policymakers will have access to a one-dimensional metric to monitor the relative success of integrating circularity across a spectrum of procurement activities and benchmark their progress with other administrations in the EU.

Testing of this indicator has demonstrated that it is feasible to measure this data and despite some limitations it is considered suitable for future development. However, it is recognised that this would require significant coordination work and capacity-building to enable cities and regions to effectively monitor this indicator in a systematic and coherent manner. This is due to key differences in terms of data availability and public procurement platforms used across EU Member States.

This study found that this indicator was not being measured by either the Municipality of Lund or Government of Catalonia, and stakeholders interviewed during the research perceived significant challenges in both standardising the reporting of this indicator, and supplying the internal resources needed to monitor this. While both administrations recognised the value of circular procurement, there was limited legislative incentive to monitor this indicator leading to different approaches being taken. In the case of the Government of Catalonia, significant work had been carried out to publish product-specific GPP guidance documents. However, their monitoring efforts only track the number of tenders containing broadly defined environmental clauses and are not broken down by product category (CPV codes) which limits how they can be used to assess sustainable or circular procurement practices across sectors. In the case of the Municipality of Lund, no comparable data existed.

In the development of this indicator, web-scraping was used as an innovative tool to monitor the presence of CE aspects in public procurement notices in a manner that was found to be replicable, relatively robust and resource effective. In the case of the Government of Catalonia, the web-scraping tool was able to analyse the supporting documents of 6,645 public procurement notices, and identify 163 potential cases where CE aspects existed. As the output of this analysis listed both the number of key terms associated with each procurement notice and the page numbers where they were located in the supporting documents, the research team were able to efficiently carry out quality assurance checks with moderate ease. The product categories analysed under this study were selected on the basis of providing a broad range of product categories. As part of the quality assurance process, a confidence threshold was set to manually review public procurement notices with equal to or under five key terms. As a result, 46 (24%) of the total number of public procurement notices were checked for the presence of CE procurement criteria. This led to the exclusion of 32 (20%) of the total number

of public procurement notices. Future research may wish to broaden this approach to either cover additional CPV-code categories or develop more specific key criteria to delve deeper into how circularity is being implemented in each category. In addition, future studies may seek to set a higher confidence threshold to evaluate the presence of CE criteria within public procurement notices.

While this was an effective method to gather and analyse procurement data during this study, its application was primarily exploratory. As web-scraping tools need to be designed to match the specific layout of individual websites and/or databases using consistent terminology and structure, their use may be unsuitable to monitor this indicator across EU Member States due to the significant technical skills and digital infrastructure that would need to be developed within each reporting administration. As such, if the EU were to formally adopt and mandate the monitoring of CE compliance, it would need to do so through more structured, policy-driven approaches, rather than web-scraping techniques. To enable this, the EC will need to consider ways of integrating circular procurement criteria into national legislation, or into EU directives. This could include the revision of the EU Procurement Directive to include mandatory reporting requirements on CE compliance for all public sector contracts above a certain value. This should be informed by the work of Eurostat in integrating GPP criteria into the CE monitoring framework from 2024 onwards.

By way of supporting specific data collection for this indicator, the EC could develop or promote the use of specific digital sourcing and procurement platforms and tools. Tool such as SAP Ariba[20], Coupa[21], Jaegger[22] allow for reporting on past sourcing events, and are used to calculate existing procurement indicators (such as savings, % of events awarded to new suppliers, etc. This is done because each event is a record with many fields, such as:

- Category
- Event type
- Owner
- Business Area
- Date started
- Date awarded
- Budget
- Final Value
- Savings
- Avoided Costs
- Awarded Supplier
- Length of contract

The complication is that many of these fields are standard, but all of the mainstream sourcing platforms allow for personalised fields because different companies and entities are interested in monitoring specific information. One personalised field could be "Circularity requirements included" which could then easily be used report on the share by number of procurement events or value.

It is therefore recommended the EC consider the development of a robust framework for monitoring and evaluating circular procurement that includes clear metrics, regular reporting intervals and standardised assessment procedures. This could be facilitated through the promotion of consistent CE terminology within tenders across municipal, regional and EU Member State levels, alongside funding for the development of CE training materials for local and regional administration procurement professionals across EU Member States. Given the evolving nature of circular best practice, regular training may need to be conducted with procurement officials on the latest CE criteria and effective monitoring practices.

To facilitate consistent reporting between EU Member States, it is also recommended that the EC defines CE aspects that should be monitored by reporting administrations. These aspects should be defined as a result of engagement with expert stakeholders to ensure they are scientifically grounded, full aligned with Net Zero outcomes, and represent robust sustainability approaches to avoid potential greenwashing through the inclusion of "weak" sustainability aspects, which may undermine their acceptability (Pelenc & Dedeurwaerdere, 2015).

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[20] SAP UK and Ireland: Business Software Solutions
[21] Coupa | All in one AI-Driven Platform
[22] JAGGAER - Leading Procurement Software Solutions

Funding may also be required to update local and regional procurement platforms so that they can easily "tag" or categorise public procurement notices containing CE criteria. By upgrading procurement platforms to better manage and analyse CE data, the EC will be able to promote the adoption of standardised data entry and reporting formats, which will facilitate easier aggregation and analysis of data across Member States. It is recommended that the EC provide funding for the development of skills training to allow local and regional administrative procurement officials to take a more standardised approach to data entry, reporting and analysis. This would improve the accuracy with which digital tools are able to identify the presence of key terms and extract relevant information, and as a result, reduce the risks of "false of positives".

Alternatively, the EC may consider shifting the focus of monitoring from focusing on the presence of CE criteria in procurement notices, to focus on spend data for products or services purchased. As most procurement platforms and software is able to flag different fields or variables in spend reports, this would provide additional data to understand the competitiveness of circular procurement activities, as opposed to the share of CE compliant notices within procurement budgets. While this is unsuitable for testing, this may be relatively easy for implementation.

Given the distorting effect that a few high value contracts may have on the overall share of CE notices stipulating CE aspects, it is recommended that future monitoring of this indicator seeks to measure both the value and number of notices stipulating CE aspects. Due to the perceived challenges in monitoring this data, an initial focus of this reporting could either target high value public procurement notices, or specific high-impact sectors, such as construction, textiles, or food and catering.

These approaches are more likely to succeed in EU Member States that have already well-established, coherent procurement platforms, as it is assumed that the organisation and labelling of notices within the platform will be consistent. These may include the public procurement platforms of Nantes Metropole[23], the Spanish government and other regional administrations in Spain[24].

The case of the Adda public procurement platform was interesting in that they operate multiple procurement frameworks containing sustainability and CE aspects and are operated by The Swedish Association of Local Authorities and Regions (SKR), which represents all of Sweden's municipalities, county councils and regions. While they were unable to participate in this research, it would be valuable to investigate whether this network would be interested in trialling future CE monitoring projects as this would generate insights into the practices of every administration of the network. This would provide a clearer understanding the feasibility of monitoring this indicator on a national scale.

Given the challenges and insights from testing, the phrasing of this indicator, "Share of public procurement notices that stipulate specific Circular Economy aspects" could be rephrased as "Share of public procurement calls for competition that stipulate non-price Circular Economy criteria aimed at reducing the environmental impact of goods, works and services throughout their lifecycle". This improves upon the previous description by drawing a causal link between the introduction of CE criteria and the objective to reduce environmental impacts. This in turn would provide a mechanism by which public procurers can actively engage with suppliers and evaluate the provision of CE goods and services.

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[23] Nantes Metropole, "MARCHES PUBLICS DEMATERIALISES" (marchespublics.nantesmetropole.fr, 2024). https://marchespublics.nantesmetropole.fr/entreprise. Accessed 01/04/2024

[24] Gobierno de Espana, "Plataforma de Contratación del sector Público" (contrataciondelsectorpublico.gob.es/, 2024) https://contrataciondelsectorpublico.gob.es/wps/portal/licitaciones. Accessed: 01/04/2024

Table 21: Summary of recommendations for indicator CR4

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
Technical review of the implementation of CE aspects in regional procurement practices.	EC to conduct extensive stakeholder engagement exercise with regional procurement officials to understand current challenges in stipulating CE aspects in procurement processes.	Medium (1.5-5 years)	Responsible I: EC Accountable (A): Municipality stakeholder responsible for public procurement Consult(C): Regional procurement platforms, CE consultancies and digital design consultancies Informed (I): Supplier networks	Acceptance Credibility Ease Robustness
Technical review of regional procurement platform capabilities.	EC to conduct stakeholder engagement exercise and gap analysis to assess the capabilities of regional procurement platforms and suitability for use of web-scraping as a monitoring tool.	Medium (1.5-5 years)	R: EC A: Municipality stakeholder responsible for public procurement C: Regional procurement platforms, CE consultancies and digital design consultancies I: Supplier networks	Ease Robustness
Replicate study in other EU cities and regions	EC to conduct additional studies in other EU cities and regions, incorporating a longer stakeholder engagement period to mitigate data gaps and limitations identified in this study. This should include engagement with national procurement platforms, where web-scraping tools may be applied, as well as development of a robust QA	Short (0-1.5 years)	R: EC A: Municipality and Regional stakeholders responsible for public procurement C: Regional procurement platforms C: CE consultancies I: Supplier networks	Credibility Ease Robustness

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
	methodology to analyse results.			
R&D investment in digital monitoring tools	EC to fund R&D investment in and promotion digital tools to enable the automated monitoring of procurement platforms at the city and regional level.	Medium (1.5-5 years)	R: EC A: Circular Cities and Regions Initiative C: Municipality stakeholder responsible for public procurement, regional procurement platforms, CE consultancies and digital design consultancies I: Supplier networks	Ease Robustness
Development of minimum legislative requirements for monitoring circular procurement practices.	The EC should introduce minimum reporting requirements for the monitoring of circularity in public procurement. Due to perceived challenges in monitoring all procurement activities, the EC should develop a minimum threshold that targets high value procurement contracts.	Medium (1.5-5 years)	R: EC A: Circular Cities and Regions Initiative C: Municipality stakeholder responsible for public procurement, regional procurement platforms and CE consultancies I: Supplier networks	Relevance Acceptance

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
Definition of key CE procurement aspects	The EC to conduct study to define key CE aspects that should be specified during procurement. This process to involve literature review and stakeholder engagement with expert stakeholders to ensure aspects are scientifically grounded, full aligned with Net Zero outcomes, and represent strong sustainability approaches to avoid potential of greenwashing through the inclusion of "weak" sustainability aspects.	Short (0.5-1.5 years)	R: EC A: Circular Cities and Regions Initiative C: Municipality stakeholder responsible for public procurement, regional procurement platforms and CE consultancies I: Supplier networks	

4. INDICATOR 3: BUDGET OF PUBLIC PROCUREMENT NOTICES THAT STIPULATE SPECIFIC CIRCULAR ECONOMY ASPECTS

This indicator is used to measure the total budget of public procurement notices that stipulate specific circular economy (CE) aspects used by local and regional administrations.

As noted by the Ellen MacArthur Foundation (EMF), circular public procurement is a 'powerful tool that city governments can use to shape the transition towards a CE' (2023).By establishing clear CE aspects within public procurement notices, public authorities can influence change at the product, supplier and market level through the purchasing of circular products and services (ICLEI, 2018).

Following the adoption of the 2020 Circular Economy Action Plan (CEAP), the European Commission (EC) has proposed introducing minimum mandatory Green Public Procurement (GPP) criteria and targets in sectoral legislation, and to phase in compulsory reporting to monitor uptake. This indicator aligns with EU GPP criteria set within the framework of Strategic Public Procurement, together with Socially Responsible Public Procurement (SRPP) and Innovation Procurement, which provide clear, verifiable, justifiable and ambitious environmental criteria to enable sustainable public procurement. This reinforces key aspects of circularity through consideration of material origins, durability, recyclability and lifecycle assessments (EU Commission, 2024).

This indicator supports these ambitions by enabling cities and regions to monitor total value of the procurement of circular products and services and benchmark their activities against other administrations. This will allow for the quantification of the average value of public procurement notices stipulating CE aspects and compare these which do not. This will provide insights that can be used to inform budgeting decisions regarding investments circular procurement.

There are several benefits to monitoring this indicator, for example:

- It is supportive of the CEAP's objective to reach a circular material use rate of 23.2% by 2030 by incentivising the integration of CE criteria within public procurement.

- Standardising how circular procurement is monitored helps promote the harmonisation of sustainable and circular public procurement practices at the local and regional level.

- It enables local and regional policymakers to benchmark their sustainable public procurement performance against other administrations at the local, regional and European level.

- This would provide a more holistic understanding of the scale (number) and impact (value) of notices stipulating CE aspects within each city. This would provide insights into sustainable procurement policy effectiveness, which would further guide targeted policy development.

- It encourages innovation within public procurement. It enables public procurers to engage suppliers on new uses for byproducts, thereby enhancing the competitiveness of industries fostering new technologies and business models.

4.1 KEY METHODOLOGY

4.1.1   Testing method

The system boundary for this indicator applied to the monitoring the value of public procurement notices stipulating specific CE aspects that have been published by one municipal administration (the Municipality of Lund, Sweden), and one regional government (the Government of Catalonia, Spain) in the time period 1st January 2023 to 31st December 2023.

The region of Catalonia was selected due to their prior work in promoting sustainable public procurement practices. As a populous region (7.98 million[25]), with a significant economic output (292.5€ billion[26]) and an autonomous status, it means that it has some scope to set its own legislative agenda. Since 2005, this has led to environmental criteria being included within most framework agreements used by the Government of Catalonia, as well as the production of GPP guides for products or services that contain recommendations broadly supportive of circular procurement outcomes, such as focusing on product durability and the use of recycled materials. However, these do not provide a comprehensive CE procurement framework. Nonetheless, as the Circular Economy for Catalunya Roadmap (FRECC) 2030 has policy objective aiming to integrate circular procurement criteria in the government's strategic documents, it was assumed this case study may represent a suitable point of comparison with other cities and regions in the EU[27].

As a smaller city, the Municipality of Lund was expected to allow the research team to test the feasibility of monitoring this indicator on a smaller scale. Having set targets to embed circular and sustainable procurement practices in their Climate Neutral Lund 2030 strategy, published in January 2022, this would also provide insights into the rate at which these changes can be implemented at the local level (Lunds Kommun, 2022).

To test this indicator, the scope of study was restricted to monitoring public procurement notices that match the specific Common Procurement Vocabulary (CPV) codes listed in Table 22 below. These CPV-codes were selected to cover a broad spectrum of potential product categories and purchasing practices of the administrations targeted during this study.

Table 22: CPV-code categories included within study

CPV-Code	Title
15000000-8	Food, beverages, tobacco and related products
18000000-9	Clothing, footwear, luggage articles and accessories
39000000-2	Furniture (incl. office furniture), furnishings, domestic appliances (excl. lighting) and cleaning products
44000000-0	Construction structures and materials; auxiliary products to construction (except electric apparatus)
45000000-7	Construction work
50000000-5	Repair and maintenance services
60000000-8	Transport services (excl. Waste transport)
71000000-8	Architectural, construction, engineering and inspection services
73000000-2	Research and development services and related consultancy services

To automate this process, the research team deployed a web-scraping tool, which used digital methods to extract data from online platforms/databases using digital software. This involves "fetching the data" where a webpage is downloaded, before data is "extracted", thereby allowing the webpage's contents to be searched,

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[25] Statista, "Population of the Spanish autonomous community of Catalonia in 2023, by age group". (Statista.com, 03/11/2024), https://www.statista.com/statistics/448882/population-of-catalonia-by-age-group/. Accessed: 09/04/2024

[26] Statista, "Gross domestic product (GDP) in Catalonia between 2003 and 2023". (Statista.com, 03/04/2024), https://www.statista.com/statistics/327097/gross-domestic-product-in-catalonia/. Accessed: 09/04/2024

[27] Generalitat de Catalunya, "Full de Ruta de l'Economia Circular a Catalunya" (mediambient.gencat.cat, 2024) https://mediambient.gencat.cat/web/.content/home/actualitat/2024/docs/FRECC_Consell-Tecnic_.pdf. Accessed: 01/04/2024.

reformatted, and analysed in a relatively efficient manner. Data extracted for the testing of this indicator included each public procurement notice's expedient code (file identifiers), their associated CPV codes, and all PDF documents associated with each notice. These PDFs were then analysed to assess the presence of predetermined key terms associated with specific CE aspects. As this process required the use of downloadable PDF documents, public procurement notices without such documents on the platforms/databases were excluded. In the case of the Region of Catalonia, this applied to a very high proportion of notices classified as "Minor Contracts" (low value contracts) on the Platform for Public Procurement for Catalonia website.

The process was conducted in five stages (detailed further below):

1. Defining key terms related to circular procurement.
2. Scraping procurement website.
3. Downloading relevant PDF documents.
4. Performing an automated PDF analysis.
5. Fuzzy matching and quality assurance.

4.1.1.1 *Defining key terms related to circular procurement*

Following the definition provided by the Ellen MacArthur Foundation (2023), circular public procurement is the process by which the public sector purchases products and services in accordance with the three principles of the CE:

- eliminate waste and pollution.
- circulate products and materials (at their highest value).
- regenerate nature.

The principles of the CE can be applied to the purchase of various products and services, such as buildings, furniture, food and packaging, among others, and can be expanded to cover a wide range of impacts across a product's lifecycle. Neither case study region has produced a comprehensive CE framework for procurement. As such, for the purposes of this study, the research team adapted themes from the Circular Procurement Ambitions Chart developed by Circular Flanders (see: Figure 1) to generate key terms in English, Catalan, and Swedish (Circular Flanders, 2024). This framework is often cited within circular procurement guidance documents produced within EU Member States, and was selected on the basis it could provide a standardised point of comparison between both case studies within the research. As to be discussed in section 4.2.24.2.2, this framework is one of several referenced by EU policymakers, and terminology may vary between regions and institutions. Nonetheless, in the absence of a clear definition of CE public procurement criteria, this framework was deemed suitable for testing the feasibility of monitoring this indicator. The key terms identified in this process are listed in Table 23Table 23 to Table 27.

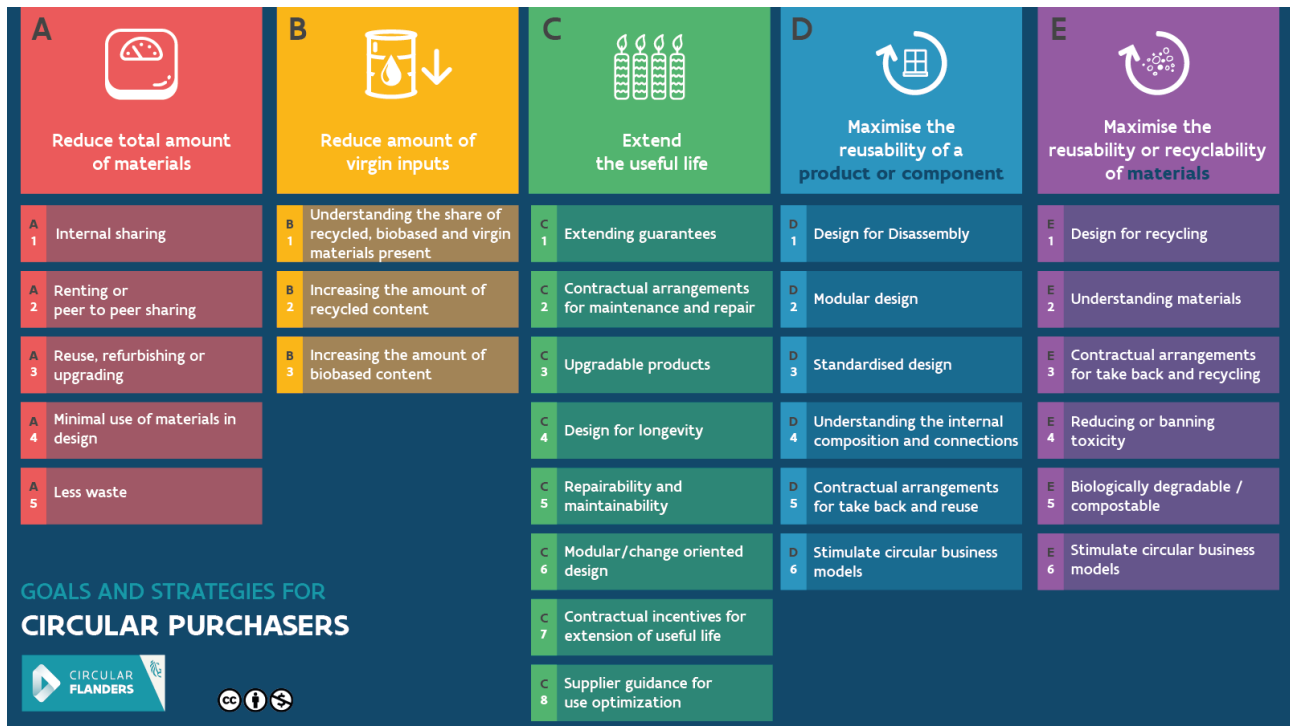Figure 1: Circular Purchasers Ambitions Chart (Circular Flanders)

Table 23: Key words associated with circular procurement ambitions to reduce the total amount of materials procured (Circular Flanders, 2024)

1	Circular Economy	Economia circular	Cirkulär ekonomi
A	Reduce total amount of materials	Redu50ossible50tntitat total de materials	Begränsa den totala materialåtgången
A2	Rent Renting	Lloguer Lloguer	Delad användning Dela Delning Hyra Uthyrning
	Lease Leasing	Arrendament Arrendament	Leasing
A3	Reuse Refurbish Upgrade	Reutilitzar Reformar Actualitza	Återanvänd Återtagning Uppgradera Uppgraderingsbara
A4	Minimal use of materia50ossi mínim de materials	Minimerad materialåtgång	
	Minimise use of materials	Minimi'zar l'ús de materials	Minimera materialåtgången
A5	Less waste	Menys residus	Mindre avfall
	Resource Efficiency	Eficiència dels recursos	Resurseffektivitet

1	Circular Economy	Economia circular	Cirkulär ekonomi
	Reduce waste	Reduir els residus	Minska avfall
	Prevent waste	Prevenir els residus	Förebygg avfall
	Waste management plan	Pla de gestió de residus	Avfallshanteringsplan
	Waste reduction plan	Pla de reducció de residus	Avfallsminimeringsplan Avfallsminskningsplan

Table 24: Key words associated with circular procurement ambitions to reduce the amount of virgin inputs in procurement (Circular Flanders, 2024)

B	Reduce amount of virgin inputs	Redu51ossible51tnt'tat d'inputs verges	Minska mängden jungfruliga råvaror
B1	Share of recycled materials	Quota de materials reciclats	Andelen återvunna material
	Share of recycled content	Part de contingut reciclat	Andelen återvunnet innehåll
	Share of biobased materials	Part de materials de base biològica	Andelen biobaserade råvaror
	Share of biobased content	Part de contingut de base biològica	Andelen biobaserat innehåll
B2	Recycled materials/content	Materials/contingut reciclats	Återvunnet material/innehåll
B3	Biobased materials/content	Materials/contingut de base biològica	Biobaserat material/innehåll

Table 25: Key words associated with circular procurement ambitions to extend the useful life of a product (Circular Flanders, 2024)

C	Extend the useful life	Allargar la vida útil	Ökad livslängd
C1	Extended guarantees	Ampliació de garanties	Förlängda garantier
C2	Agreements for Maintenance	Acords de Manteniment	Avtal om underhåll
	Agreements for Repair	Acords de reparació	Avtal om reparationer
	Maintenance service	Servei de manteniment	Underhåll
	Repair service	Servei de reparació	Reparation
C3	Upgradable product	Producte actualitzable	Uppgraderingsbar produkt
	Upgradability	Actualització	Möjlighet att uppgradera
C4	Design for longevity	Disseny per a la longevitat	Design för ökad livslängd
	Design for durability	Disseny per a la durabilitat	Design för hållbarhet
	Durability	Durabilitat	Hållbarhet
C5	Repairability	Reparabilitat	Möjlighet att reparera
	Maintainability	Mantenibilitat	Möjlighet att underhålla

C	Extend the useful life	Allargar la vida útil	Ökad livslängd
C6	Modular design	Disseny modular	Modulär design
C7	Product life extension	Allargament de la vida útil del producte	Ökad livslängd för produkt
	Extension of useful life	Ampliació de la vida útil	Förlängd livslängd
	Extend functional lifetime	Ampliar la vida útil functional	Förlängd funktionell livslängd
C8	Supplier guidance for use optimisation	Orientació del proveïdor p'r a l'optimitz'ció d'ús	Vägledning från tillverjare för optimal användning
	Guidance for product maintenance	Orientació per al manteniment del producte	Vägledning för produktunderhåll

Table 26: Key words associated with circular procurement ambitions to maximise the possibility of a product or component (Circular Flanders, 2024)

D	Maximise the reusability of a product or component	Maximitzar la reutilitz'ció d'un producte o component	Maximera möjligheten för återanvändning 52ossiblrodukt eller komponent
D1	Design for disassembly	Disseny per al desmuntatge	Design för demontering
D2	Modular design	Disseny modular	Modulär design
D3	Standardised design	Disseny estandarditzat	Standardiserad design
D5	Take back scheme/system	Es52ossiblistema de recuperació	Återtagningssystem
	Take back and reuse scheme/system	Es52ossiblistema de recupelació i reutilització	Återanvändningssystem
D6	Circular business models	Models de negoci circulars	Cirkulära affärsmodeller
	Circular economy business models	Models de n'goci d'economia circular	ibid

Table 27: Key words associated with circular procurement ambitions to maximise the reusability or recyclability of materials (Circular Flanders, 2024)

E	Maximise the reusability of materials	Maximitzar la reutilització dels materials	Maximera möjligheter till återanvändning och återvinning av material
E1	Design for recycling	Disseny per al reciclatge	Design för återvinning
E2	Understanding materials	Comprensió dels materials	Förstå material
E3	Contractual agreements for take back and recycling	Acords contractuals de recuplració i reciclatge	Avtal om återintag och återvinning
	Take back and recycling service	Servei de reculeració i reciclatge	Tjänst för återvinning och återintag

E	Maximise the reusability of materials	Maximitzar la reutilització dels materials	Maximera möjligheter till återanvändning och återvinning av material
	Collection for recycling	Recollida per al reciclatge	Insamling för återvinning
E4	Reduce toxicity	Reduir la toxicitat	begränsning eller förbud av farliga ämnen
	Restricted chemicals	Substàncies químiques restringides	
E5	Biologically degradable	Degradable biològicament	Biologiskt nedbrytbara
	Biologically compostable	Biològicament compostable	Biologiskt komposterbara
	Biodegradable	Biodegradable	ibid
	Compostable	Compostable	ibid

4.1.1.2 Scraping procurement website

The web-scraping process was initiated by opening the target procurement website and navigating through it to extract and download procurement notices based on the predefined CPV code. This process is detailed in the script (a web-scraping tool) provided in Appendix 5.6. This step downloaded all relevant data associated with notices for the CPV codes listed above (Table 22), including publication date and value.

This process followed the following key steps:

- **Setup:** Selenium WebDriver (a browser plug-in) was used to automate browser interactions, with ChromeDriver (an open-source tool for testing webapps) configured to handle downloads.
- **Accept Cookies/T&Cs:** The script navigated to the search page of the procurement website and programmatically accepted cookies or terms and conditions to proceed.
- **CPV Codes Iteration:** The script iterated over a list of CPV codes, performing searches to gather procurement notices related to these codes.
- **Data Extraction:** For each CPV code, the script scraped relevant data from the search results, including expedient codes, tender procedures, and links to detailed notice pages.
- **Exclusion of Minor Contracts:** Notices tagged as 'minor 'contracts' by a public procurement platform were excluded from the process due to the lack of downloadable PDF documents necessary for key term matching.

4.1.1.3 Downloading relevant PDF documents

Following the initial scraping, all the PDF documents available associated with each non-excluded procurement notice were downloaded. This included downloading the listed technical specifications, justifications, contracts and evidence associated with each identified procurement notice's expedient code.

This process followed the following key steps:

- **Iteration Over Notices:** The script iterated over the previously scraped data, visiting ea'h notice's detail page.
- **PDF Links Identification:** It identified links to downloadable PDF documents based on the document type (e.g., Technical specification documents; "Plec de prescripcions "ècniques" in Catalan).
- **PDF Download:** Relevant PDF documents were downloaded and saved in a structured directory based on CPV codes and expedient codes.

4.1.1.4 Performing an automated PDF analysis

Another script provided in Appendix 5.6 analysed the downloaded PDF documents, searching for the key terms, extracting specific information to quantify the results of this indicator, such as the frequency of key term

use, and their specific location in supporting documentation, which enables further quality assurance processes.

4.1.1.5 Fuzzy matching and quality assurance

Fuzzy matching, which is a web-scraping technique to review strings of text for similarities, identifying similar, but not identical elements in data, were applied where exact matches between data fields were not feasible due to variations in naming conventions or typos. This approach enhanced data matching accuracy beyond simple string comparisons.

This process involved the following key steps:

- A matching criterion of 95% was set to ensure that as close a match to the key terms was made as possible, while allowing for variation.
- This data was extracted into an MS Excel document, where pivot tables were used to summarise all expedient codes containing key term matches within the relevant public procurement notice documentation, the specific key terms matched, alongside the frequency of matches.
- It was assumed that the fewer total number of key term matches there were, the less likely it was that these procurement notices contained true matches with CE aspects, potentially leading to "false positives" (where the automated tool detected the presence of key terms in supporting documents of notices with no CE aspects). To mitigate this risk, a threshold for the level of confidence in the accuracy of the automated process was established, as described below:
  - If notices contained less than a total of five key term matches, a low level of confidence in the accuracy of the automated check was assumed, and therefore the supporting documents were manually checked for the presence of CE aspects.
  - If notices contained a total of five or more key terms matches, a high level of confidence in the accuracy of the automated check was assumed, and therefore the supporting documents were not manually checked for the presence of CE aspects.
- The level of the threshold was defined on the basis of feasibility within the timeframe and budget of this project as manual checks are time consuming. As such, future research wishing to apply the same methodology, may wish to set a higher threshold for study to improve further the accuracy of the results.

4.1.1.6 Output from this testing method

All the data from each of these steps were combined within an MS Excel a spreadsheet for further analysis, which allowed the research team to calculate the results for this indicator.

4.1.2 Data collection method

This indicator has three data requirements:

- Pre-defined CE key terms.
- The value (€) of each public procurement notices published in the period January to December 2023 that are listed in Table 22.
- The value (€) of each public procurement notices published in the period January to December 2023 that are listed in Table 22 that have CE aspects.

To collect this data, the research team carried out desk-based search and stakeholder engagement to identify data sources and relevant procurement officials in both Lund and Catalonia to ensure access to procurement data and sense-check findings once data collection was complete.

Desk-based search

Desk-based search was conducted to identify public procurement platforms used by each case study city and region and relevant stakeholders.

To identify relevant stakeholders, the research team carried out desk-based review of public procurement policy statements, reports, briefing notes, conference itineraries relevant to each city/region's sustainable procurement policies, as well as regional procurement agencies. Once a stakeholder had been identified, these were evaluated for relevance according to area of responsibility and how up to date the data source was.

Initial search terms used (translated into official language of region using DeepL for Swedish and Spanish, and Google Translate for Catalan):

- ("Green public procurement" OR "Sustainable procurement" OR "Circular procurement") AND ("Department" OR "agency") AND ("City" OR "Region")

4.1.2.1 Stakeholder engagement

The research team conducted two 60-minute interviews, one with relevant stakeholders from the Municipality of Lund and one with relevant stakeholders of the Government of Catalonia's public procurement services.

The interviews had three purposes:

- To ensure that the research team had identified the correct data sources.
- To request quantitative data relevant to this indicator.
- To understand the perceived challenges and long-term aspirations of each city/region in relation to measuring this indicator.

In the case of the Government of Catalonia, key stakeholders interviewed included representatives from the following departments of the Government of Catalonia's public procurement services: Public Procurement, the Regulation and Supervision of Public Procurement, the Public Procurement Consultative Board of Catalonia and Centralised Purchasing. During this interview, the research team confirmed that the terms defined were accurate and relevant, and that the most relevant public procurement platform that should be used was the Plataforma de Serveis de Contració Publica (referred to throughout as the Public Procurement Platform of Catalonia)[28].

Following the interview, the research team developed the web-scraping tool, downloaded all relevant metadata for the period of January 2023 to December 2023 from the Public Procurement Services of Catalonia platform and conducted the testing of this indicator.

In the case of the Municipality of Lund, key stakeholders interviewed included representatives of the Municipality of Lund's Public Procurement department. During the interview, key terms were confirmed as relevant, however, the municipality were not able to provide access to a local public platform where relevant metadata could be downloaded. This was because the municipality uses the Adda platform, a procurement service operated and used by the majority of Sweden's municipalities, for the management of their procurement services[29]. The research team contacted Adda to request access to data specific to the Municipality of Lund. However, due to commercial sensitivities, they were not able to provide access to the research team, nor share details on which contracting authority had procured goods from specific frameworks. To mitigate this data gap, the research team distributed a Microsoft Forms survey to public sector organisations within the legal boundaries of Lund to collect the data needed. The survey questions are listed in Appendix 5.2.1.

4.1.3 Calculations

To calculate the budget of public procurement notices that stipulate specific CE aspects as a value, the following formula was used:

$$CR8: Total\ budget\ of\ public\ procurement\ notices\ that\ stipulate\ specific\ CE\ aspects$$
$$=$$
$$Accumulative\ value\ of\ public\ procurement\ notices\ that\ stipulate\ specific\ CE\ aspects$$

The analysis also calculated the average value of procurement notices containing CE aspects which was calculated by dividing the total value of public notices containing CE aspects per CPV category and dividing these by the total number of procurement notices containing CE aspects.

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[28] Paltaforma de Serveis de Contractació Pública, "Public procurement services of Catalonia Platform use data" (https://contractaciopublica.cat/en/inici, 2024). Plataforma_de_Serveis_de_Contractació_Pública_(contractaciopublica.cat). Accessed: 01/04/2024
[29] Adda Inköpscentral, "Om oss" (https://www.adda.se, 2024). https://www.adda.se/om-oss/about-adda/. Accessed: 01/04/2024

4.1.4 Timeline

This process took place in a fourteen-week period between December 2023 and March 2024, as detailed in the Table 28 below.

Table 28. Gantt chart

Week Commencing	01-Jan	08-Jan	15-Jan	22-Jan	29-Jan	05-Feb	12-Feb	19-Feb	26-Feb	04-Mar	11-Mar	18-Mar	25-Mar	01-Apr
Review Green Public Procurement Action Plans	X													
Desk-based research to identify data sources.	X	X	X	X	X									
Engage relevant stakeholders to request procurement data		X	X	X	X					X				
Development & application of Web-scraping tool.						X	X	X	X	X				
Analysis and write up of findings											X	X		
Review period							X			X			X	
Key deliverables											X		X	

4.1.5 Data gaps and mitigation

Table 29 summarises the data gaps and mitigations associated with testing this indicator.

Table 29. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	The data required to assess this indicator is not being monitored in a systematic or robust manner.	• The research team used a web-scraping tool to identify the presence of specific CE terms used within tender documents listed on digital public procurement databases.	High
2	At the national level, the Open Tender and Tenders Electronic Daily (TED) databases register all tenders above EU thresholds, including whether environmental considerations have been considered. However, because of many missing values and the absence of a standard format, the numbers remain estimates.	• Where limited information was found online, the research team engaged with public procurers from the relevant municipalities and regions to verify findings and sources of information. • Development and application of web-scraping tool to automate quantification of tenders containing CE aspects as listed on government public procurement data bases.	High
3	No access to Lund public procurement database.	• Attempts to conduct stakeholder surveys of public sector organisations in the city were made to request estimations on the number of public procurement notices containing CE aspects. • 61 organisations were emailed however, no responses were received. Therefore, it was not possible to quantify this indicator for the city of Lund.	Low
4	Terminology for CE aspects may vary across languages.	• The research team used translation software to translate key terms from English to Swedish and Catalan. • As the Government of Catalonia has published GPP guidance documents in Catalan, which contain recommendations for CE aspects, such as for product durability and the use of recycled materials, the terms were cross referenced with the translated key terms in Tables 22 to 26 to ensure consistency between them.	Medium

4.1.6   Quality review of analysis

To ensure robust and high-quality results, Ricardo conducted the following data validation and quality control procedures:

- Prior to work beginning, the Project Director reviewed the proposed research methodology and ensure that the data collection plan is fit for purpose. Once the research team addressed any comments from the review process, they proceeded to the data collection phase.

- The research team built an MS Excel database to record relevant procurement data for publicly purchased products stipulating CE aspects for each case study city. This was reviewed by the Project Director prior to analysis being conducted.

- The research team presented semi-structured interview guides and a list of stakeholders identified for interview to the Project Director for review prior to interviews being carried out.

- The Project Director held responsibility for the quality of the final case study output. During the review period, the Project Director and senior subject matter experts were involved in judging the quality of the output and suggesting ways to improve.

Results of the quality review of the automated process

The manual review of the automated process resulted in 32 of 46 tenders with fewer than five matches (defined as 'weak') being checked and discarded from the list. These exclusions were expected as only the matches defined as 'weak' were manually checked. The reasons for these were summarised in the Table 30 below.

Table 30: Summary of procurement notices excluded from the analysis of public procurement notices for the Government of Catalonia

Reasons for expedient exclusion	Number	Share of excluded expedients
The expedient does not contain CE aspects	20	62.50%
Key word was not found in the expedient	7	21.88%
Could not find the expedient	5	15.63%
Total	**32**	**100%**

These results demonstrates that while the use of similar web-scraping tools are able to save significant time and resources, it is also necessary to factor resourcing for manual quality assurance checks for tenders with a low frequency of key term matches.

4.2   KEY ANALYSIS RESULTS

4.2.1   Analysis

Table 31 below presents the budget of public procurement notices that stipulate CE aspects (in €) for the Government of Catalonia for the period January 2023 to December 2023, as well as their average value by product category. Please see Appendix 5.5 for further details on the results.

Table 31: Summary of key results for the budget of public procurement notices stipulating CE aspects

Results of web-scraping analysis	Government of Catalonia
Total budget of public of public procurement notices stipulating CE aspects (in €)	€ 48,983,356.41
Average value of notices stipulating CE aspects	€ 300,511.39

Table 32 below presents the analysis of public procurement notices for each product category in the Region of Catalonia for the period January 2023 to December 2023. Of the 6,645 public procurement notices analysed,

163 were found to contain specific CE aspects, with a total value of €48,983,356.41. While these notices represented 7.88% of the total value of all notices analysed during the study, the analysis shows these are on average of significantly higher value.

In the product category Food, beverages, tobacco and related products (CPV code 15000000-8), six procurement notices were identified to contain CE aspects, with a total value of € 12,641,453.66. These notices average at around € 2,106,901 in value per procurement notice, approximately 56% higher than notices without CE aspects.

In terms of Clothing, footwear, luggage articles and accessories (CPV 18000000-9), it was found that while 8 out of 22 public procurement notices were found to contain CE aspects, these were on average 54% lower in value than their non-CE equivalent, with procurement notices containing CE aspects had an average value of € 76,592.23 against € 141,088.57 for notices without CE aspects.

In the product category, Furniture, furnishings, domestic appliances and cleaning products (CPV 39000000-2), the value of notices stipulating CE aspects came to a total of €181,113.92 against €2,213,929.98 for notices without CE aspects. Interestingly, while only 5 of 1395 notices contained CE aspects, these notices were of much higher value (€36,222.78 against €1,587.05). This represents the largest difference between average values and further analysis may seek to understand the cause of this difference by analysing this category by sub-category, for example by differentiating between notices for Furniture (CPV 39100000-3), Furnishings (39200000-4) and Cleaning and polishing products (39800000-0), where possible.

Interestingly there is a distinction between the product category Construction structures and materials (CPV code 44000000-0) and Construction work (CPV code 45000000-7). For the former, 4 notices were identified to contain CE aspects with a total value of € 92,959.46 compared to 140 notices without CE aspects, which had a total value of € 858,139.26. As a result, the average value of procurement notices stipulating CE aspects amounts to € 23,239.87, which is almost four times higher than the average for their non-CE equivalent.

By contrast, notices containing CE aspects within the category Construction Work were found to be on average €130,195 lower in value than their non-CE equivalent, where 64 notices containing CE aspects had a total value of € 21.3 million and an average value of € 332,806, compared to notices without CE aspects, which had an average value of €463,001 and a total value of €279.6 million.

In terms of repair and maintenance services (CPV code 50000000-5), 32 notices containing CE aspects had a total value of € 5,560,924.66, compared against 688 notices without CE aspects, which had a total value of €131.2 million. While a significant difference in total spend can be identified, the average value of these notices are relatively similar with a difference of just under 9% between them (€173,778.90 for notices stipulating CE aspects, against €190,710.27, without).

In terms of Transport services (CPV code 60000000-8), 6 notices stipulating CE aspects were identified, with a total value of €506,895.00, compared to 486 notices with a total value of €2.28 million without CE aspects. Similar to the results for CPV code 39000000-2, this results in a significant difference in average notice values where the average notice containing CE aspects had a value of €84,482.50 compared to €4,706.86 without CE aspects.

Likewise, in terms of Architectural, construction, engineering and inspection services (CPV code 71000000-8) 29 notices with a total value of €7.43 million were identified to contain CE aspects compared against 3072 notices with a total value of €59,65 million, not containing CE aspects, again leading to a significant difference in the average values (€256,330.90 with CE aspects; €19,419.47 without).

Finally, in terms of Research and development services and related consultancy services (CPV code 73000000-2), 9 notices with a total of € 654,070.91 were found to stipulate CE aspects, compared to 39 notices with a total value of €13.04 million without CE aspects.

Table 32: Analysis of the total and average value of expedients containing specific CE aspects

CPV-Code	15000000-8	18000000-9	39000000-2	44000000-0	45000000-7	50000000-5	60000000-8	71000000-8	73000000-2	Total Value
Total value of expedients without CE aspects	€ 48,646,828.63	€ 3,103,948.48	€ 2,213,929.98	€ 858,139.26	€ 279,652,815.62	€ 131,208,668.94	€ 2,287,535.83	€ 59,653,554.70	€ 13,038,841.36	**€ 540,664,262.80**
Total number of notices without CE aspects	36	22	1395	140	604	688	486	3072	39	**6482**
Total value of notices containing CE aspects	€ 12,641,453.66	€ 612,737.87	€ 181,113.92	€ 92,959.46	€ 21,299,604.78	€ 5,560,924.66	€ 506,895.00	€ 7,433,596.15	€ 654,070.91	**€ 48,983,356.41**
Total number of notices containing CE aspects	6	8	5	4	64	32	6	29	9	**163**
Average value of notices without CE aspects	€ 1,351,300.80	€ 141,088.57	€ 1,587.05	€ 6,129.57	€ 463,001.35	€ 190,710.27	€ 4,706.86	€ 19,418.47	€ 334,329.27	**€ 83,410.10**
Average value of notices containing CE aspects	€ 2,106,908.94	€ 76,592.23	€ 36,222.78	€ 23,239.87	€ 332,806.32	€ 173,778.90	€ 84,482.50	€ 256,330.90	€ 72,674.55	**€ 300,511.39**
Difference in the average value between notices containing CE and non-CE aspects	€ 755,608.15	- € 64,496.33	€ 34,635.74	€ 17,110.30	- € 130,195.03	- € 16,931.38	€ 79,775.64	€ 236,912.43	- € 261,654.72	**€ 217,101.29**
Difference as a percentage	156%	54%	2282%	379%	72%	91%	1795%	1320%	22%	**360%**

4.2.2 Limitations

4.2.2.1 *Data availability and completeness*

In the case of the Government of Catalonia, while the research team were able to identify a number of tenders listed on the Public Procurement Platform of Catalonia, there are some limitations and uncertainties associated with this data.

- The testing method was limited to assessing only the tenders listed on this platform that had uploaded supporting documents in a PDF format. While this enabled the research team to efficiently assess the presence of key terms within the majority of the listed tender's technical specifications, the research team had to exclude a significant number of "minor contracts" from the analysis, as they had been listed on the platform without any form of supporting evidence that could be analysed for CE aspects. On average these represent over 71% of the total number of listed procurement notices per CPV code. While in the majority of cases these represented a relatively insignificant share of total value per CPV code (less than 1.5% of total value per CPV code), for CPV-codes 39000000-2 (Furniture, furnishings, domestic appliances and cleaning products) and 44000000-0 (Construction structures and materials), these respectively represent 44.87% and 49.23% of the total value per CPV code. As such, these minor contracts represent a relatively significant proportion of public procurement activity which currently cannot be monitored using automated web-scraping tools. Please see Appendix 5.5 for further information on this data.

- To ensure the research was feasible within the time allocated, the scope of the research was restricted to a limited range of CPV codes, and excluded other key product categories such as Electrical machinery (CPV code 31000000-6) and Medical Equipment (CPV code 33000000-0). As such, the results are not fully representative of all the public procurement activities in this region and may result in underreporting for this indicator.

- In addition, the government stakeholders interviewed noted the potential of inconsistencies in how the CPV codes used to categorise each tender had been uploaded to the platform. This is due to the fact that each municipality within the region was responsible for uploading data to the platform and it was challenging to standardise each municipality's practices and eliminate human error. It was recognised that more training and guidance may be needed to reduce this in the future, but in the short term this was beyond the scope of this study. The only relevant data point they had access to were general figures on the number of tenders that contained broadly defined environmental clauses, however, these were not broken down by product type (CPV codes) or requirement. As such, stakeholders interviewed noted this would be inappropriate proxy to monitor this indicator.

- Finally, due to availability issues, it was not possible to conduct a follow-up interview to sense-check findings with representatives once analysis had been completed, reducing the opportunity to either identify potential anomalies in the data assessed or the practicality of stakeholders within the administration of using this method in their own processes.

To mitigate these issues, the research team conducted an email survey of 13 administrations in the City of Barcelona and a further 11 municipalities with a population above 72,500 inhabitants in the region of Catalonia to request estimations on the proportion and value of public procurement notices that contained CE aspects. This resulted in no responses within the data collection period. Nonetheless, it was thought that the research team was able to analyse the listed public procurement notices with a reasonable level of confidence.

In the case of the Municipality of Lund, the efforts to test this indicator produced no results due to the way in which procurement practices in Sweden are managed. Indeed, commercial contract information can only be accessed via the intermunicipal procurement platform, Adda, which the research team could not get access to or to the data it contains due to commercial sensitivities. Attempts to mitigate this through the use of a survey targeting stakeholders in 61 public sector organisations in the city of Lund also resulted in no response within the data collection period. Therefore, this indicator could not be measured for that region and the analysis could not be compared with results from other EU Member States.

Taking these two cases into account, future monitoring efforts should also consider limitations imposed by external factors on the availability of data. The impact of the current economic climate, alongside the impact of public budgets, can influence the extent to which CE criteria are prioritised or implemented by public

administrations, both in terms of spend on CE compliant products and services, as well as in terms of resources invested in monitoring their presence in public procurement.

Finally, it is important to consider the limitations of web-scraping more broadly as an approach to monitoring this data. As noted in Section 4.1.12.1.1, web-scraping scripts are developed to match the specific architecture/layouts of the websites they are designed to extract data from. As websites often change their layouts, this can require web-scraping scripts to be frequently updated to avoid them breaking. In addition, this might not be easily scalable across different regions or products due to varied data availability and technology, as well as require a fairly high level of technical expertise within reporting administrations that might not be readily available. Even with web-scraping, there may also be gaps in data coverage due to differences in how procurement notices are published or archived. This methodology is therefore limited by a dependency on published data. As indicated by the exclusion of minor contracts in this study, this may result in incomplete datasets as all relevant transactions may not be publicly disclosed or documented.

4.2.2.2   Scope of study

Analysis of these results indicate a need to differentiate between the total number of notices stipulating CE aspects and their value. The analysis shows that on average public procurement notices stipulating CE aspects tended to be fewer in number but of significantly higher value than those which do not. In addition, significant variation between the average value of notices identified within product group was recorded, as highlighted by results for the product category for Furniture, furnishing, domestic appliances and cleaning products, wherein notices containing CE aspects were 2282% higher than notices without. Due to time constraints, it was not possible to conduct more granular analysis of these notices to explain these differences.

These variations may result in different policy responses for each product category. For example, policymakers may use these findings to prioritise incentivising the introduction of CE aspects into higher value public procurement notices. As these appear to be relatively fewer in number, the results of this approach may be relatively easier to monitor and may have a higher impact due to the scale of these contracts. Nonetheless, focusing primarily on a budgetary indicator could pose a limitation by potentially undervaluing environmental benefits. For example, numerous lower value contracts might offer significant circular benefits, but their impact could be overshadowed by a few high-value contracts that, despite stipulating circular economy aspects, contribute limited environmental value. This imbalance could distort metric comparison across different regions and Member States, leading to skewed perceptions of progress towards circular goals.

Due to the higher frequency of lower value contracts, administrations should be encouraged to avoid limiting the scope of their activities and encourage the uptake of circular practices in procurement more broadly.

4.2.2.3   Data quality

To mitigate the risk of false positives (notices wrongly identified by the automated process as having CE aspects), a quality assurance methodology was developed using a threshold for the level of confidence in the automated process. This level was set as follows: any notice that had a count of less than five key term matches within the supporting documents were deemed to have a potentially "weak" relationship to CE aspects. This threshold was defined on the basis of feasibility within the timeframe and budget of this project as manual checks are time consuming and therefore, only a small number of notices identified were reviewed.

As a result, 24% of notices containing key term matches were manually reviewed. While this represents a significant proportion of the overall results, given the novelty of this approach, future research may seek to set a higher threshold to remove any remaining erroneous results.

4.2.2.4   Definition of key CE terms

There is limited consensus on what criteria can be included within CE procurement. While the use of the framework developed by Circular Flanders allowed the research team to adapt high level CE criteria across a range of aspects, these are not specific to particular product categories, where circularity might be applied in different ways. For example, while the criteria used in this study address different stages of a product or service's lifecycle, they do not indicate the extent to which circularity has been comprehensively embedded within the procurement process. In other words, it is possible that a tender may contain a high frequency of key terms associated with product life-extension processes (e.g. repair, refurbishment, and product as a service), without full consideration of the full lifecycle impacts associated with material selection or the end-of-

life management. As a result, this may draw into question the environmental benefits of these public procurement notices, and the extent to which these can be considered truly "circular".

In addition, it is acknowledged that other countries may have different views for what constitutes circularity within their contexts. Indeed, the Circular Procurement for Cities framework, published by the EMF, underlines these factors by stating "Public procurement processes differ from one city to another and therefore this guide is not a one-size-fits-all solution. Instead, it provides an overarching framework that should be adapted to your local context and the realities of your city" (Ellen MacArthur Foundation, 2023).

As such, the use of terminology adapted from the Circular Flandres framework may have potentially contributed to false negatives, whereby notices containing CE aspects that were not identified by the automated web-scraping tool are not counted. This risk is impossible to mitigate without developing a more comprehensive, standardised list of commonly accepted CE terms and aspects.

4.2.3   Performance

Table 33 below compares the RACER score allocated to the original indicator during Task 4 against the final indicator after the Task 5 testing process. During Task 4, the original indicator was allocated a score of 12 against the RACER evaluation process. Following testing of the feasibility and practicality of measuring this indicator n Task 5, the indicator was allocated a score of 10, for the reasons summarised below:

- **Relevance**: This refers to whether the indicator is closely linked to the objectives to be researched. From analysis of the web-scraping results for Catalonia, there was evidence that it was possible to monitor the budget of public procurement notices containing requirements for CE aspects, such as recycled content, EU ecolabels, and design for durability, and therefore alignment with EU policy objectives. As such, the score of "Good" (3) remained unchanged as it was assessed to be fully aligned with EU policy objectives.

- **Acceptability**: This refers to whether the indicator is perceived to be of value to, and used by key stakeholders, such as procurement stakeholders within local and regional administrations. Through stakeholder engagement it was noted that the benefits of monitoring this indicator were clear and stakeholders reported interest in understanding how this could be measured in the future. At the same time, they noted that current challenges in relation to collecting data remained a significant barrier. As such, the score remained as "Neutral" (2) following testing.

- **Credibility**: This refers to whether the indicator is transparent, trustworthy and easy to interpret. While this indicator was easy to understand and to communicate to stakeholders, it was found that there was no easily applicable methodology that could be adopted by municipalities. This was due to the clear differences in the way in which local and regional administrations manage public procurement. While on the one hand, web-scraping greatly improved the way in which data can be collected, this would need to be enabled by cities and regions standardising their procurement systems to allow monitoring to be rolled out across cities and regions across EU Member States. As such, scoring for Credibility has been downgraded to "Neutral" (2).

- **Ease**: This refers to the easiness of measuring and monitoring the indicator. The score was downgraded to "Poor" (1). While the use of the web-scraping tool allowed the research team to download and assess data from the Government of Catalonia's public procurement platform with relative ease, this process was not possible in the case of Lund due to the use of the Adda platform which did not allow access to the data needed to assess this indicator.

- **Robustness**: This refers to whether data assessed is biased and whether it comprehensively assesses circularity. The score remained unchanged as "Neutral" (2). Despite the noted challenges in collecting data for reporting, this remained a one-dimensional indicator with a consistent methodology.

Table 33. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	3	2	3	2	2	12
After Task 5 (following testing)	3	2	2	1	2	10

4.3 CHALLENGES AND LESSONS LEARNED

4.3.1 Challenges

4.3.1.1 Data availability

This was a challenging indicator to monitor as there is currently no legislative requirement for cities or regions to publicly disclose the number or value of public procurement notices that stipulate CE aspects. As such, neither the Municipality of Lund nor the Government of Catalonia had access to comparable data to monitor this indicator.

The representatives of the Government of Catalonia's procurement departments interviewed noted that while this indicator aligns with policy objectives within their Circular Economy for Catalunya Roadmap (FRECC) 2030, this may be challenging to implement (Generalitat de Catalunya, 2024)[30]. While the government has developed GPP guidelines for procurement, these are not mandatory nor are they explicitly linked to CE outcomes. There is also no monitoring of whether or how municipalities within the region are seeking to apply due to challenges in coordinating such efforts as the regional level. Please note that the Government of Catalonia monitors the presence and value of "environmental clauses" in public procurement contracts, but these are not defined by product category or type of clause.[31] Following stakeholder engagement, it was found that this data would not be a suitable proxy for this indicator.

In the case of Lund, municipality representatives noted that the use of a web-scraping tool might not be feasible for the monitoring of CE aspects in procurement notices. While the Municipality would have access to some public procurement notices (for example the purchasing of uniforms for street cleaners and maintenance workers), the majority of public sector procurement activities are being conducted via the Adda procurement platform and issues surrounding data access was perceived as a challenge.

Through email correspondence with a representative of the Adda procurement platform, it was noted that while they offer workwear framework agreements that contain specific sustainability requirements aligned with CE aspects (for example in terms of durability), they currently do not monitor whether the municipalities/regions procuring through the framework agreement have chosen to purchase from suppliers that meet these criteria. In addition, the representative noted that it was not possible to release information about which contracting authorities have made contracts through the frameworks they provide due to commercial sensitivities.

From this, it is anticipated that the accessibility of procurement databases will remain a persistent challenge across EU Member States due to a lack of standardisation of procurement practices at the municipal, regional, and state-wide level. In particular, the lack of standardised data formats across different procurement platforms will likely complicate data aggregation and analysis. To mitigate these limitations in the future, greater coordination between public and private procurement databases will be required to ensure greater availability of data.

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[30] Generalitat de Catalunya, "Full de Ruta de l'Economia Circular a Catalunya" (mediambient.gencat.cat, 2024) https://mediambient.gencat.cat/web/.content/home/actualitat/2024/docs/FRECC_Consell-Tecnic_.pdf. Accessed: 01/04/2024.
[31] Generalitat de Catalunya, "Contractació pública: Clausulas ambientales" (Contratacio.gencat.cat, 2023) https://contractacio.gencat.cat/ca/difusio/publicacions/indicadors/grafics/clausulas-ambientals-en/. Accessed: 01/04/2024.

4.3.1.2 *Data quality*

To mitigate any risks of false positives, a quality assurance (QA) methodology was developed to manually check any public procurement notice that fell below the confidence threshold of five key term matches. While this allowed the research team to conduct QA checks on 46 public procurement notices (24% of total results), future research may seek to develop a more robust QA methodology and set a higher threshold for manual checks.

4.3.1.3 *Definition of key CE aspects*

Given the potential variation in the way circular procurement concepts are defined and applied across EU Member States, noted in Section 4.2.2, it may be challenging for EU policymakers to ensure administrations take a consistent approach to monitoring this indicator. Without a standardised, critically reviewed, list of key CE aspects that should be monitored, there is a potential risk of bias or loosely defined CE criteria negatively influencing how this data is reported. In addition, different regions and Member States might have varying regulatory standards and requirements for public procurement, that would make it more it difficult to apply a uniform approach to integrating and monitoring CE aspects. This might result in a disparity between administrations that apply more stringent criteria for assessment and administration which apply more loosely defined criteria, thereby potentially undermining the credibility of results generated.

4.3.1.4 *Stakeholder engagement*

It is understood that stakeholders may have limited time and resources to contribute to future research and monitoring efforts, which can affect the quality and completeness of the information gathered. Nonetheless, their input is an important factor in mitigating issues surrounding data availability and quality. Stakeholder engagement should therefore be prioritised in future indicator development.

4.3.2 Lessons learned

4.3.2.1 *Automated data collection process*

In the case of the region of Catalonia, the application of a web-scraping tool greatly facilitated the ease with which the indicator was monitored, and the results analysed. The "modular" functionality of the tool allowed the research team to take an iterative approach to organising the metadata downloaded, refining key search criteria, and identifying results where a "weak" relationship to key CE aspects may exist. This process greatly improved the efficiency with which research can be carried out, however, as demonstrated by the number of exclusions, it does not negate the need for manual QA checks on the results generated.

While this approach is replicable, it should be noted that each web-scraping tool is essentially bespoke as they are designed to navigate the architecture of specific websites or databases, and it is not possible to reapply these tools between websites or databases. As such, if this method is applied in future assessments, then future research teams will need to designate time in designing individual web-scraping tools per database. If research teams wished to set a higher confidence threshold to remove erroneous results, this will also need to be factored into how time is budgeted for the study. In the case of Catalonia, the research team benefited from the fact that procurement notices were publicly listed on a platform that was free and open to access. In the case of Lund, this was not possible, as access to the Adda platform was restricted due to commercial sensitivities.

Therefore, future research teams wishing to test the feasibility of using web-scraping as a method to monitor this indicator will need to follow one of two approaches, either:

- Identify local and regional administrations that operate publicly accessible procurement platforms, and contain tender specifications and/or supporting evidence relevant to the indicator being assessed. For example, during initial desk-based search it was found that several regional and national administrations operate publicly accessible procurement platforms similar to the Catalonian Public

Procurement Platform. These include Nantes Metropole[32], the Spanish government and other regional administrations in Spain[33].

- Alternatively, research teams may reach out to the operators of restricted procurement platforms, such as Adda, to gauge interest in participating in similar research in the future.

In addition, future research may seek to analyse the value of notices stipulating of specific CE aspects within public notices, such as requirements for recycled content, packaging reuse schemes or repair services. This would increase the granularity of results generated and act as a market signal to encourage suppliers to provide these services.

4.3.2.2 Stakeholder engagement

The research team sought to mitigate data gaps associated with both areas under study through the use of stakeholder surveys to request estimations on the value of public procurement notices stipulating CE aspects in their public procurement activities. This was a resource- and time-intensive approach, and generated no results during the data collection period. Therefore, future mitigation efforts should seek to factor in a longer stakeholder engagement period.

4.3.2.3 Measuring impact

The research indicates the need to measure both the number and share of public procurement notices stipulating CE aspects. As noted in Section 4.2.1, a small number of high value procurement notices may have a distorting effect on the results for this indicator and, by extension, how circular procurement practices are monitored and reported on within each city and/or region. This contributes to notable variations in the average value of procurement notices analysed per product category, which may suggest that either i) circular procurement is being prioritised in larger projects, ii) circular products and services are more expensive, iii) suppliers of lower value notices may not have the capacity to provide circular products or services, or iv) that the products and services being supplied through the lower value non-CE notices are not directly equivalent in scale or scope. Future research should seek to understand these differences.

The initial findings suggest that policymakers may benefit from analysing both factors (number of notices and value) together. This would provide a more holistic understanding of the scale (number) and impact (value) of notices stipulating CE aspects within each city.

Finally, as noted in Section 4.2.2, it was not possible to analyse the presence of CE aspects within "minor" notices for the region of Catalonia. Minor procurement activities tend to be published for low value contracts awarded to local small and medium enterprises (SME) and suppliers, where for expediency administrations utilise framework agreements and automated processes to efficiently award contracts. In the case of Catalonia, it appears that supporting documents (e.g. tenders, technical specifications, awarding criteria) for these minor contracts have not been uploaded to the region's public procurement platform. Given the streamlined nature of minor procurement process, it is likely that this might be replicated in other regions.

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[32] Nantes Metropole, "MARCHES PUBLICS DEMATERIALISES" (marchespublics.nantesmetropole.fr, 2024). https://marchespublics.nantesmetropole.fr/entreprise. Accessed 01/04/2024

[33] Gobierno de Espana, "Plataforma de Contratación del sector Público" (contrataciondelsectorpublico.gob.es/, 2024) https://contrataciondelsectorpublico.gob.es/wps/portal/licitaciones. Accessed: 01/04/2024

4.4 CONCLUSIONS AND RECOMMENDATIONS

It is recommended that this indicator is considered for further development, with significant work required to facilitate its progress.

Public procurement remains one of the most powerful tools that local and regional administrations have at their disposal to accelerate the transition to a CE. By stipulating CE aspects within public procurement notices, cities and regions are able to stimulate sustainable innovation and increase demand for circular product and service offerings. By requiring local and regional administrations to report on the budget of procurement notices stipulating CE requirements, policymakers will have a mechanism to monitor the relative success of integrating circularity across a spectrum of procurement activities and benchmark their progress with other administrations in their region.

Testing of this indicator has demonstrated that it is feasible to measure this data and despite some limitations it is considered suitable for future development. However, it is recognised that this would require significant coordination work and capacity-building to enable cities and regions to effectively monitor this indicator in a systematic and coherent manner. This is due to key differences in terms of data availability and public procurement platforms used across EU Member States.

This study found that this indicator was not being measured by either the Municipality of Lund or Government of Catalonia, and stakeholders interviewed during the research perceived significant challenges in both standardising the reporting of this indicator, and in supplying the internal resources needed to monitor this. While both administrations recognised the value of circular procurement, there was limited legislative incentive to monitor this indicator in both cases. In the case of the Government of Catalonia, significant work had been carried out to publish product-specific GPP guidance documents. However, their monitoring efforts only track the number of tenders containing broadly defined environmental clauses and are not broken down by product category (CPV codes) which limits how they can be used to assess sustainable or circular procurement practices across sectors. In the case of the Municipality of Lund, no comparable data existed.

In the development of this indicator, web-scraping was used as an innovative tool to quantify the budget of public procurement notices stipulating CE aspects in a manner that was found to be replicable, relatively robust and resource effective. In the case of the Government of Catalonia, the web-scraping tool was able to analyse the supporting documents of 6,645 public procurement notices, identify 163 potential cases where CE aspects existed. This enabled the research team to quantify the total and average budgets of notices stipulating CE aspects in nine product group categories. As the output of this analysis listed both the number of key terms associated with each procurement notice and where they were located within each relevant supporting document, the research team was able to efficiently carry out quality assurance checks with moderate ease. The product categories analysed under this study were selected on the basis of providing a broad range of product categories. As part of the quality assurance process, a confidence threshold was set to manually review public procurement notices with equal to or under five key terms. As a result, 46 (24%) of the total number of public procurement notices were checked for the presence of CE procurement criteria. This led to the exclusion of 32 (20%) of the total number of public procurement notices.

As discussed in the conclusions for Indicator 2, a simpler approach may be for the EU to engage with the development and use of existing digital procurement platforms and tools. Encouraging their use in a way that records the presence of circularity stipulations in a standardised way, making reporting and tracking of this indicator much simpler.

Future research may wish to broaden this approach to either cover additional CPV-code categories or develop more specific key criteria to delve deeper into how circularity is being implemented in each category. In addition, it is advised that a more granular approach to analysis is taken by comparing budgets by sub-category to control for potentially significant variations in the value of notices found within product groups, as suggested by the analysis of data for CPV code 39000000-2. In addition, future studies may also seek to set a higher confidence threshold to evaluate the presence of CE criteria within public procurement notices.

While this proved an effective method to gather and analyse procurement data in this study, its application was primarily exploratory. As web-scraping tools need to be designed to match the specific layout of individual websites and/or databases using consistent terminology and structure, their use may be unsuitable to monitor

this indicator across EU Member States due to the significant technical skills and digital infrastructure that would need to be developed within each reporting administration. As such, if the EU were to formally adopt and mandate the monitoring of the budgets allocated to circular public procurement, it would need to do so through more structured, policy-driven approaches, rather than web-scraping techniques. To enable this, the EC will need to consider ways of integrating circular procurement criteria into national legislation, or into EU directives. This could include the revision of the EU procurement directive to include mandatory reporting requirements on CE compliance for all public sector contracts above a certain value. This should be informed by the work of Eurostat in integrating GPP criteria into the CE monitoring framework from 2024 onwards.

It is therefore recommended the EC consider the development of a robust framework for monitoring and evaluating circular procurement that includes clear metrics, regular reporting intervals and standardised assessment procedures. This could be facilitated through the promotion of consistent CE terminology within tenders across municipal, regional and EU Member State levels, alongside funding for the development of CE training materials for local and regional administration procurement professionals across EU Member States. Given the evolving nature of circular best practice, regular training may need to be conducted with procurement officials on the latest CE criteria and effective monitoring practices.

To facilitate consistent reporting between EU Member States, it is also recommended that the EC defines CE aspects that should be monitored by reporting administrations. These aspects should be defined as a result of engagement with expert stakeholders to ensure they are scientifically grounded, full aligned with Net Zero outcomes, and represent robust sustainability approaches to avoid potential greenwashing through the inclusion of "weak" sustainability aspects, which may undermine their acceptability (Pelenc & Dedeurwaerdere, 2015).

Funding may also be required to update local and regional procurement platforms so that they can easily "tag" or categorise public procurement notices containing CE criteria. By upgrading procurement platforms to better manage and analyse CE data, the EC will be able to support the adoption of standardised data entry and reporting formats, which in turn will enable easier aggregation and analysis of procurement data across Member States. To support this aim, the EC should consider funding for the development of skills training to allow local and regional administrative procurement officials to take a more standardised approach to data entry, reporting and analysis. This would improve the accuracy with which these platforms can be used to calculate the budget of notices stipulating CE aspects, thereby reducing risks associated with "false positives" and misreporting.

These approaches are more likely to succeed in EU Member States that have already well-established, coherent procurement platforms, as it is assumed that the organisation and labelling of notices within the platform will be consistent. These may include the public procurement platforms of Nantes Metropole[34], the Spanish government and other regional administrations in Spain[35].

The case of the Adda public procurement platform was interesting in that they operate multiple procurement frameworks containing sustainability and CE aspects and are operated by The Swedish Association of Local Authorities and Regions (SKR), which represents all of Sweden's municipalities, county councils and regions. While they were unable to participate in this research, it would be valuable to investigate whether this network would be interested in trialling future CE monitoring projects as this would generate insights into the practices of every administration of the network. This would provide a clearer understanding the feasibility of monitoring this indicator on a national scale.

Given the challenges and insights from testing, the phrasing of this indicator, "Budget of public procurement notices that stipulate specific Circular Economy aspects" could be rephrased as "Number and value of public contracts awarded based on Circular Economy criteria aimed at reducing the environmental impacts of goods, works and services throughout their lifecycle". This improves upon the previous description by drawing a causal link between the introduction of CE criteria and the objective to reduce environmental impacts. This in turn provides a mechanism by which public procurers can actively engage with suppliers on the provision of CE goods and services and encourage the uptake of sustainable innovations.

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[34] Nantes Metropole, "MARCHES PUBLICS DEMATERIALISES" (marchespublics.nantesmetropole.fr, 2024). https://marchespublics.nantesmetropole.fr/entreprise. Accessed 01/04/2024

[35] Gobierno de Espana, "Plataforma de Contratación del sector Público" (contrataciondelsectorpublico.gob.es/, 2024) https://contrataciondelsectorpublico.gob.es/wps/portal/licitaciones. Accessed: 01/04/2024

Table 34: Summary of recommendations for indicator CR8

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
Technical review of the implementation of CE aspects in regional procurement practices.	EC to conduct extensive stakeholder engagement exercise with regional procurement officials to understand current challenges in stipulating CE aspects in procurement processes.	Medium (1.5-5 years)	Responsible (R): EC Accountable (A): Municipality stakeholder responsible for public procurement Consulted (C): Regional procurement platforms, CE consultancies and digital design consultancies Informed (I): Supplier networks	Acceptance Credibility Ease Robustness
Technical review of regional procurement platform capabilities.	EC to conduct stakeholder engagement exercise and gap analysis to assess the capabilities of regional procurement platforms and suitability for use of web-scraping as a monitoring tool.	Medium (1.5-5 years)	R: EC A: Municipality stakeholder responsible for public procurement C: Regional procurement platforms, CE consultancies and digital design consultancies I: Supplier networks	Ease Robustness
Replicate study in other EU cities and regions	EC to conduct additional studies in other EU cities and regions, incorporating a longer stakeholder engagement period to mitigate data gaps and limitations identified in this study. This should include engagement with national procurement platforms, where web-scraping tools may be applied, as well as development of a robust QA	Short (0-1.5 years)	R: EC A: Municipality and Regional stakeholders responsible for public procurement C: Regional procurement platforms and CE consultancies I: Supplier networks	Credibility Ease Robustness

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
	methodology to analyse results.			
R&D investment in digital monitoring tools	EC to fund R&D investment in, and promotion of, digital tools to enable the automated monitoring of procurement platforms at the city and regional level.	Medium (1.5-5 years)	R: EC A: Circular Cities and Regions Initiative C: Municipality stakeholder responsible for public procurement, regional procurement platforms, CE consultancies and digital design consultancies I: Supplier networks	Ease Robustness
Development of minimum legislative requirements for monitoring circular procurement practices.	The EC should introduce minimum reporting requirements for the monitoring of circularity in public procurement. Due to perceived challenges in monitoring all procurement activities, the EC should develop a minimum threshold that targets high value procurement contracts.	Medium (1.5-5 years)	R: EC A: Circular Cities and Regions Initiative C: Municipality stakeholder responsible for public procurement, regional procurement platforms and CE consultancies I: Supplier networks	Relevance Acceptance

Type of recommendation	Recommendation	Timeline	Key stakeholders or partners	RACER relevance
Definition of key CE procurement aspects	The EC to conduct study to define key CE aspects that should be specified during procurement. This process to involve literature review and stakeholder engagement with expert stakeholders to ensure aspects are scientifically grounded, full aligned with Net Zero outcomes, and represent strong sustainability approaches to avoid potential of greenwashing through the inclusion of "weak" sustainability aspects.	Short (0.5-1.5 years)	R: EC A: Circular Cities and Regions Initiative C: Municipality stakeholder responsible for public procurement, regional procurement platforms and CE consultancies I: Supplier networks	Relevance Credibility Robustness
Develop methodology for granular analysis of procurement data	EC to fund research into further developing research methodology to analyse the presence of CE aspects within public procurement, while controlling for variation within product categories.	Medium (1.5-5 years)	R: EC A: Circular Cities and Regions Initiative C: Municipality stakeholder responsible for public procurement, regional procurement platforms, data scientists and CE consultancies I: Supplier networks	Credibility Ease Robustness

5. APPENDICES

During the research process, data collection for indicators CR1, CR4, CR8 and FWN2 were combined to ensure efficiencies were made in contacting relevant stakeholders and requesting data.

5.1 STAKEHOLDER INTERVIEWS

Below you will find a summary of the stakeholders interviewed during the research of indicators CR1, CR4, CR8, and FWN2, alongside a summary of questions asked.

5.1.1 Stakeholder list

Table 35: Stakeholders interviewed during research

ID	Interview Date	Administration	Stakeholder title
SC1	30/01/2024	Government of Catalonia	Directora General de Contratación Pública
SC2	30/01/2024	Government of Catalonia	Subdirectora General de Regulación y Supervisión de la Contratación Pública
SC3	30/01/2024	Government of Catalonia	Secretaría Técnica de la Junta Consultiva de Contratación Pública
SC4	30/01/2024	Government of Catalonia	Subdirectora general de Compra Centralizada
SL1	05/02/2024	Municipality of Lund	Purchaser at Lund Municipality
SL2	05/02/2024	Municipality of Lund	Purchaser at Lund Municipality

5.1.2 Interview questions

Table 36: Stakeholder interview questions for indicators FWN2, CR1, CR4, CR8

Themes	Interview Questions for FWN2, CR1, CR4, and CR8
FWN2	**Presence of requirements for organic products in public-procurement of food (%)**
Data measurement	Is this region measuring this data point?
Procurement codes:	Are there specific procurement codes (e.g. CPV 150000000 or 15000000-8) used to identify tenders containing criteria relevant to organic food products or food and catering services?
Standardised criteria:	How uniform are the criteria for public food procurement?
Certification requirements:	What types of organic certifications are recognised in public procurement policies?
Contract quantification:	Can the region quantify the total number of public procurement contracts specifically for food procurement?
CR1	**Share of publicly purchased products following EU GPP criteria (%)**
Data measurement:	Is this region measuring this data point?
Procurement codes:	Are there specific procurement codes used to identify tenders containing criteria relevant to Textile products and services?

Themes	Interview Questions for FWN2, CR1, CR4, and CR8
Standardised criteria:	How standardised are the criteria for the public procurement of Textile products and services?
CR4	**Share of public procurement notices that stipulate specific CE aspects (%)**
Data measurement:	Is this region measuring this data point?
Procurement codes:	Are there specific procurement codes used to identify tenders containing circular economy or sustainability criteria?
Standardised criteria:	How standardised are the criteria for the stipulation of specific Circular Economy aspects?
Standardised criteria:	Are there specific guidelines or templates used?
Training:	Is there a training programme for procurement officials to understand and apply circular economy aspects in procurement notices?
Contract quantification:	Can the region identify the total number public procurement notices?
CR8	**Budget of public procurement notices that stipulate specific CE aspects (€)**
Data measurement:	Is this region measuring this data point?
Data measurement:	Are there specific funds used for public procurement initiatives stipulating specific CE aspects?

5.2 PUBLIC PROCUREMENT SURVEY

To mitigate the risk of potential data gaps arising from web-scraping or stakeholder interview process, the research team distributed a survey to public sector bodies and institutions in the City of Lund, and to public administrations in the region of Catalonia.

5.2.1 Survey questions

Title	Survey to understand Sustainable Public Procurement practices of [Lund / Catalonia]
Survey period	**1st February 2024 to 3rd March 2024**
Introduction	This survey is designed to gather insights on the adoption of sustainable and circular economy practices in public procurement within the EU. Your participation will contribute valuable data to a study commissioned by the EC, aimed at understanding how public sector organisations are aligning with net zero and circular economy goals through their procurement activities. This survey covers the procurement of organic food, textile products and services adhering to EU GPP criteria, and the integration of circular economy aspects into procurement practices. This survey should take approximately **5 minutes** to complete. We appreciate your input by **3rd March 2024**.
Section 1	**Organic Food Procurement**
Q1	Does your department/municipality procure food?
Response	Options: • Yes • No • Don't know

Title	Survey to understand Sustainable Public Procurement practices of [Lund / Catalonia]
Q2	For the procurement of food, does your department/municipality typically use single contracts or framework agreements?
Response	[Free text response]
Q3	What is the total number of contracts related to food that your department or municipality issued from January 2023 to December 2023?
Response	[Free text response]
Q4	Please specify the percentage of food procurement contracts that included organic food requirements? **Definition:** Organic food, fresh or processed food produced by organic farming methods. Organic food is grown without the use of synthetic chemicals, such as human-made pesticides and fertilisers, and does not contain genetically modified organisms (GMOs). Organic foods include fresh produce, meats, and dairy products as well as processed foods such as crackers, drinks, and frozen meals. **Examples of organic certifications include**: the Nordic Swan EcoLabel, Catalan Organic Certification (CCPAE), and others following EU Regulation (CE) 834/2007
Response	Options: • 0-25% • 26-50% • 51-75% • 76-100%
Section 2	**EU Green Public Procurement compliance for textiles**
Introduction	**Definition:** EU GPP aims to leverage public procurement as a tool to drive sustainability, reduce environmental impact, and influence market practices toward more eco-friendly solutions. There are 14 product groups currently covered by GPP. In this project, we will focus on the Textile products and services criteria (2017). **Examples of textile products include:** 1. Textile clothing and accessories: uniforms, workwear and personal protective equipment. 2. Interior textiles: bed linen, towels, curtains, upholstery fabric and mattresses. **Examples of GPP criteria that might be included**: 1. Criteria for sustainable, organic or recycled materials 2. Criteria to reduce use of environmentally harmful and hazardous substances, 3. Criteria to reuse or recycle materials, 4. Criteria for repair, maintenance or recycling services.
Q5	Does your department/municipality procure textile products or services?
Response	Options: • Yes • No • Don't know
Q6	If yes, what types of textile products or services does your department/municipality typically procure?
Response	[Free text response]
Q7	If yes, what is the total number of contracts for textile products or services did your department/municipality issue from January 2023-December 2023?
Response	[Free text response]

Title	**Survey to understand Sustainable Public Procurement practices of [Lund / Catalonia]**
Q8	Does your department/municipality follow EU GPP criteria for textile products and services?
Response	Options: • Yes • No • Don't know
Q9	Please specify the percentage of textile contracts that complied with EU GPP criteria
Response	Options: • 0-25% • 26-50% • 51-75% • 76-100%
Section 3	**Circular economy criteria in procurement**
Introduction	We would like to understand how many public procurement notices stipulate circular economy criteria. **Definition**: The circular economy is defined as a framework to address global challenges such as climate change, biodiversity loss, waste and pollution. It is based on three principles, all driven by design: 1. Eliminate waste and pollution. 2. Circulate the use of products and materials (at their highest value). 3. Regenerate nature and biodiversity. **Examples of circular aspects include**: 1. Purchasing recycled products or materials 2. Promoting the reuse of products or materials. 3. Promoting repair, maintenance and remanufacturing services. 4. Ensuring the recyclability and recycling of products and materials.
Q10	How many public procurement notices did your department/municipality issue from January 2023 to December 2023? (Number / Don't know)
Response	[Free text response]
Q11	How many public procurement notices did your department/municipality issue from January 2023 to December 2023? (Number / Don't know)
Response	[Free text response]
Q12	Please specify the percentage of public procurement notices that included specific Circular Economy aspects?
Response	Options: • 0-25% • 26-50% • 51-75% • 76-100%
Q13	What was the total value for contracts that included Circular Economy criteria?
Response	[Free text response]

5.2.2   Stakeholder list (Public procurement survey)

Table 37: Public administration, public sector and municipality department stakeholders contacted to participate in public procurement survey (Municipality of Lund)

ID	Institution Name	Sector	City	Email
L1	Lund Municipality	Procurement	Lund	maria.bronn@lund.se
L2	Lund Municipality	Procurement	Lund	jeanette.jakobsson@lunde.se
L3	Lund Municipality	General	Lund	lunds.kommun@lund.se
L4	Dalby	Civic Centre	Lund	medborgarcenter.dalby@lund.se
L5	Genarp	Civic Centre	Lund	medborgarcenter.genarp@lund.se
L6	Veberod	Civic Centre	Lund	medborgarcenter.veberod@lund.se
L7	Emergency Services: Social Workers	Emergency Services	Lund	uppsok@lund.se
L8	Emergency Services: Street, roads and park	Emergency Services	Lund	n/a
L9	Emergency Services: Home service	Emergency Services	Lund	n/a
L10	Emergency Services: Water and sewer	Emergency Services	Lund	n/a
L11	Family Centre	Social Services	Lund	anhorigcenter@lund.se
L12	Employment Unit: Work Centre	Social Services	Lund	n/a
L13	Culture	Leisure Services	Lund	kultur-fritid@lund.se
L14	Folkparken Library	Education	Lund	biblioteket.folkparken@lund.se
L15	Nobbelov Library	Education	Lund	biblioteket.nobbelov@lund.se
L16	Bus Lund Library	Education	Lund	biblioteksbussen@lund.se
L17	Councelling	Social Services	Lund	comung@lund.se
L18	SESAM Activity Centre	Leisure Services	Lund	ornvagen2@gmail.com
L19	Dalby Library	Leisure Services	Lund	biblioteket.dalby@lund.se
L20	Lund Lido	Leisure Services	Lund	hogevall@lund.se

ID	Institution Name	Sector	City	Email
L21	Linero Leisure Centre	Leisure Services	Lund	fritid.linero@lund.se
L22	Events	Leisure Services	Lund	info@visitlund.se
L23	Business	Business	Lund	naringsliv@lund.se
L24	Genarps Library	Leisure Services	Lund	biblioteket.genarp@lund.se
L25	Hogevall Leisure Centre	Leisure Services	Lund	hogevall@lund.se
L26	Klostergardens Library	Education	Lund	biblioteket.klostergarden@lund.se
L27	Art Gallery	Leisure Services	Lund	lundskonsthall@lund.se
L28	Culture School	Leisure Services	Lund	kulturskolan@lund.se
L29	Lilla Café	Leisure Services	Lund	lillacafeet@lund.se
L30	Linero Library	Education	Lund	biblioteket.linero@lund.se
L31	Lun City Library	Education	Lund	folkbiblioteken@lund.se
L32	Lund City Theater	Leisure Services	Lund	stadsteatern@lund.se
L33	Norra Library	Education	Lund	biblioteket.norrafaladen@lund.se
L34	School Library Centre	Education	Lund	sbc@lund.se
L35	Urban Development	Urban Development	Lund	kommunikation@lund.se
L36	Stangby Library	Education	Lund	biblioteket.stangby@lund.se
L37	Sodra Sandby Library	Education	Lund	biblioteket.sandby@lund.se
L38	Slangbellan Theater	Leisure Services	Lund	helena.gerdmar@lund.se
L39	Veberods Library	Education	Lund	biblioteket.veberod@lund.se
L40	Backaskolan School	Education	Lund	Catrine.dahlborg@lund.se
L41	The Village School	Education	Lund	byskolan@lund.se
L42	Faladsgarden School	Education	Lund	faladsgarden@lund.se

ID	Institution Name	Sector	City	Email
L43	Faladsskolan School	Education	Lund	faladsskolan@lund.se
L44	Hagalund School	Education	Lund	barnochskola@lund.se
L45	Hedda Andersson School	Education	Lund	heddagymnasiet@lund.se
L46	Cathedral School	Education	Lund	katedralskolan@lund.se
L47	Nyvangskolan	Education	Lund	nyvangskolan@lund.se
L48	Polhem School	Education	Lund	polhemskolan@lund.se
L49	Skane County	Hospitals and Health Care	Lund	region@skane.se
L50	Skane University Hospital	Hospitals and Health Care	Lund	Contact us - Skåne University Hospital (skane.se)
L51	Lund Universtiy	Education	Lund	johanna.sandahl@kommunikation.lu.se
L52	Lund Municipality	Waste Management	Lund	renhallningsverket@lund.se
L53	The Dolphin School	Education	Lund	manuela.modrow@lund.se
L54	International School of Lund	Education	Lund	islk@lund.se
L55	Palette School	Education	Lund	erik.friede@lund.se
L56	The Presbyterian School	Education	Lund	tajana.frklickrznar@lund.se
L57	Spyken School	Education	Lund	spyken@lund.se
L58	The Swan School	Education	Lund	erik.friede@lund.se
L59	Tunaskolan	Education	Lund	tunaskolan@lund.se
L60	The Viking School	Education	Lund	carl.forsblad@lund.se
L61	Vipan School	Education	Lund	vipan@lund.se

Table 38: Public administration and municipality departments contacted to participate in public procurement survey (Region of Catalonia)

ID	Body contacted	Type	Location	Email
C1	Ajuntament de Barcelona	Public administration	Barcelona	bcnsostenible@bcn.cat
C2	Districte de Sant Martí	Public administration	Barcelona	E:contractaciosantmarti@bcn.cat
C3	Gerència de Serveis Urbans i Manteniment de l'Espai Públic	Municipality department	Barcelona	contractacio_ecologia_urbana@bcn.cat
C4	Districte de Ciutat Vella	Public administration	Barcelona	contractataciociutatvella@bcn.cat
C5	Districte de Sant Andreu	Public administration	Barcelona	rid09@bcn.cat
C6	Districte de Sants-Montjuïc	Public administration	Barcelona	contractaciosantsmontjuic@bcn.cat
C7	Districte de Sarrià-Sant Gervasi	Public administration	Barcelona	contractacio.sarriasantgervasi@bcn.cat
C8	Districte de les Corts	Public administration	Barcelona	contractaciolescorts@bcn.cat
C9	Districte de Gràcia	Public administration	Barcelona	contractaciogracia@bcn.cat
C10	Gerència de Política Econòmica i Desenvolupament Local (no actual)	Municipality department	Barcelona	contractacio_recursos@bcn.cat
C11	Districte de Nou Barris	Public administration	Barcelona	contractacionoubarris@bcn.cat
C12	Districte de l'Eixample	Public administration	Barcelona	contractacio_eixample@bcn.cat
C13	Districte d'Horta-Guinardó	Public administration	Barcelona	recursosinterns.hortaguinardo@bcn.cat
C14	Gerència d'Àrea de Cultura, Educació , Esports i Cicle de Vida	Municipality department	Barcelona	contractacio_areaCECC@bcn.cat
C15	Gerència d'Àrea de Drets Socials, Salut, Cooperació i Comunitat	Municipality department	Barcelona	serveisjuridics0200@bcn.cat
C16	L'Hospitalet de Llobregat (Hospitalet de Llobregat)	Public administration	Catalonia	contractacio@l-h.cat
C17	Terrassa (Tarrasa)	Public administration	Catalonia	contractacio@terrassa.cat

ID	Body contacted	Type	Location	Email
C18	Badalona	Public administration	Catalonia	central-contractacio@badalona.cat
C19	Sabadell	Public administration	Catalonia	perfilcontractant@ajsabadell.cat
C20	Mataró	Public administration	Catalonia	contractacions@ajmataro.cat
C21	Santa Coloma de Gramenet (Santa Coloma de Gramanet)	Public administration	Catalonia	serveicontractacio@gramenet.cat
C22	Sant Cugat del Vallès (San Cugat del Vallés)	Public administration	Catalonia	contractacio@santcugat.cat
C23	Cornellà de Llobregat (Cornellá de Llobregat)	Public administration	Catalonia	contractacio@aj-cornella.cat
C24	Sant Boi de Llobregat (San Baudilio de Llobregat)	Public administration	Catalonia	contractacio@santboi.cat
C25	Rubí	Public administration	Catalonia	contractacio@ajrubi.cat
C26	Manresa	Public administration	Catalonia	contractacio@ajmanresa.cat

5.3 DATA COLLECTION PLANS

5.3.1   Data Collection Plan for indicator CR1

Policy theme / sub-theme	Cities and Regions
Indicator	**Share of publicly purchased products following EU GPP criteria.**
URN	**CR1**
Responsibilities	James Foss (Consultant) from Ricardo is the lead for this indicator. The below table provides an overview of the roles and responsibilities of the various stakeholders. *(See table below)*
Data sources	*(See content below)*

James Foss (Consultant) from Ricardo is the lead for this indicator. The below table provides an overview of the roles and responsibilities of the various stakeholders.

Name of stakeholder	Key responsibilities
Ricardo	• Ricardo will be responsible for collecting procurement data for publicly purchased products following EU GPP criteria for the specified city and/or region. • Once Ricardo has saturated all available data sources, Ricardo will contact relevant municipality/regional circular economy representatives to sense check findings. • Ricardo will request support from Norion and Circle Economy for support in contacting these stakeholders in Barcelona, Nantes, and Maribor.
Local municipalities	• To sense-check findings of desk-based research and to identify additional circular economy support programmes within their city/region. • To participate in stakeholder interviews if necessary.

Table 1: Overview of key responsibilities for data collection

Method:

To ensure efficiencies in the research process, data collection will be combined with indicators CR4 and CR8.

The research team will develop an initial nine question survey to be sent to each city. Three questions will request quantitative data relevant to each indicator, with a further six questions to request qualitative data on i) the city/region's challenges in monitoring this data, ii) the city/region's long-term aspirations for measuring this indicator. This will be followed up by a 30 minute telephone interview to discuss this data in more detail.

Desk Based research to identify data sources and stakeholders:

- To identify relevant stakeholders, the research team will carry out desk-based online review of public procurement policy statements, reports, briefing notes, conference itineraries relevant to each city/region's sustainable procurement policies, as well as regional procurement agencies. Once a stakeholder has been identified, these will be evaluated for relevance according to area of responsibility and how up to date the data source is.
- **Initial search terms to use (to be translated into official language of region using DeepL):**

- o ("Green public procurement" OR "Sustainable procurement" OR "Circular procurement") AND ("Department" OR "agency") AND ("City" OR "Region")
- **Other Data Sources to include:**
  - o LinkedIn groups, such as the Circular Procurement Learning network, to identify relevant stakeholders.
  - o Open tender: this will contain tender data for EU member states and regions.
  - o Eurostat: Eurostat will be adding EU GPP criteria to the CE monitoring framework from 2024. They will be contacted to understand what data sources are being used for this.

Input data:

- Total value of publicly purchased products for the city/region (€)
- Total value of publicly purchased products following EU GPP criteria (€)

Output data:

- Share of publicly purchased products following EU GPP criteria. (%)

Source	Reliability*	Availability**
Municipality stakeholders	High	Medium
Open tender https://opentender.eu/es/start	Medium	Low
Eurostat	Low	Low
CircPro	Medium	Medium
City of Barcleona: Guide to Sustainable Public Procurement	Medium	Low

Table 2: Overview of key data sources

* Low = Some data will likely be missing and incomplete, which may lead to inaccurate conclusions, Medium = The data will likely be complete but may lack accuracy and quality, High = The data will likely be complete, accurate and of high quality.

** Low = The data is not already collected or readily available, and will be difficult to collect. Medium = The data is already collected but is not publicly available, OR the data is not already collected but is easy to collect, High = The data is readily available and can be accessed easily.

City / Region	Stakeholder body	Existing contact	Comment	Accessibility
All	ICLEI / Procura+		Procura+ are a network of Europeasurvn public authorities that connect, exchange and act on sustainable innovation procurement. They are likely to have data and/or relevant stakeholder contacts	Medium (may have contacts in public authorities of cities/regions)

	All	EU GPP Helpdesk (Operated by ICLEI)		May be able to suggest potential data sources and/or stakeholders in relevant cities of study.	Medium (may have contacts in public authorities of cities/regions)
	City Council of Barcelona	Mar Campanero i Sala, Sustainable City Council Programme		Listed as the contact on Procura+ for the City of Barcelona (Head of Environmental Qualification System) mcampanero@bcn.cat – found via Procura+ (do not use just yet)	Medium
		María Jose Sarrias, General Directorate of Environmental Quality Generalitat de Catalunya, Government of Catalonia		Listed as the contact on Procura+ for the Government of Catalonia (Head of Environmental Qualification System)	Medium
		Mr. Albert Olives, head of Economic Analysis of the General Directorate of Public Procurement Mrs. María José Sarrias, head of the Environmental Qualification Service of the General Directorate of Environmental Quality and Climate Change		Two speakers listed at the "5th Exchange Conference on green public procurement in Catalonia" organised by the Government of Catalonia	Medium
	Municipality of Nantes	Laurence Cesbron, Reseco		RESECO is a network for Public Procurement and Sustainable Development that unites communities willing to introduce social and environmental requirements in their procurement policy.	High

			They have no contacts with Paris, but do work with Nantes.	
	Patricia Dupré-Cormerais, Nantes Metropolis		Listed as contact for the GPP In Practice issue no.74 (Sept 2017) case study: Promoting responsible purchasing in Nantes. Contact may be out of date.	Low
	City of Maribor	Regional Development Agency of Podraje Maribor		The regional development agency oversee the sustainable development of Prodrajve Maribor and its 41 component municipalities. They were responsible for development of the city's circular economy strategy, including ambitions for green-, sustainable- and circular public procurement	Low
		Igor Kos, Wycycle Institute		The WCYCLE Institute was established by the City of Maribor, with its public utility companies, as a joint platform for the development and implementation of circular economy. Igor Kos, listed as key point of contact in several online resources: circular city funding guide, Strategy for the transition to Circular Economy in the Municipality of Maribor (Regions and Cities European week, 2018)	Low

Data validation and quality control procedures

To ensure robust and high-quality results, Ricardo will conduct the following data validation and quality control procedures:

- Prior to work beginning, the Project Director (Jess Twemlow) will review the proposed research methodology and ensure that the data collection plan is fit for purpose. Once the research team has addressed any comments from the review process, they will proceed to the data collection phase.

- The research team will build an excel database to record relevant procurement data for publicly purchased products following EU GPP criteria for each case study city. This will be reviewed by the Project Director prior to analysis being conducted.

	• The research team will present semi-structured interview guides and a list of stakeholders identified for interview to the Project Director for review prior to interviews being carried out.
	• Andrew Dunwoody will hold responsibility for the quality of the final case study output. Rob Snaith will assist Andrew Dunwoody in judging the quality of the output and suggesting ways to improve.
Data storage and backup procedures	Data will be stored in the Cities and Regions folder of the DG-RTD project Sharepoint. Once each file has been processed for quality control or has received substantial changes, these will be numbered and saved (e.g. v0.1, v0.2, etc) to ensure all substantive changes are appropriately recorded.
	During the research process, the research team will save digital copies of work being completed in their individual hard drives to prevent the loss of data.
Data security and confidentiality measures	Data will only be stored on the Ricardo SharePoint, which can only be accessed via VPN. Where data is sourced through stakeholder engagement, the research team will ensure that correct GDPR procedures are carried out and the stakeholder consents to data being used. We will ensure that all team members are trained on these issues and understand our internal procedures/policies.

5.3.2   Data Collection Plan for CR4

Policy theme / sub-theme	**Cities and Regions**
Indicator	**Share of public procurement notices that stipulate specific CE aspects**
URN	**CR4**
Responsibilities	**James Foss (Consultant)** from Ricardo is the lead for this indicator. The below table provides an overview of the roles and responsibilities of the various stakeholders.

Name of stakeholder	Key responsibilities
Ricardo	• Ricardo will be responsible for collecting procurement data for public procurement notices that stipulate specific CE aspects for the specified city and/or region.
	• Once Ricardo has saturated all available data sources, Ricardo will contact relevant municipality/regional circular economy representatives to sense check findings.
	• Ricardo will request support from Norion and Circle Economy for support in contacting these stakeholders in Barcelona, Nantes, and Maribor.

| Local municipalities | • To sense-check findings of desk-based research and to identify additional circular economy support programmes within their city/region. |
| | • To participate in stakeholder interviews if necessary. |

Table 1: Overview of key responsibilities for data collection

Data sources

Method:

To ensure efficiencies in the research process, data collection will be combined with indicators CR1 and CR8.

The research team will develop an initial nine question survey to be sent to each city. Three questions will request quantitative data relevant to each indicator, with a further six questions to request qualitative data on i) the city/region's challenges in monitoring this data, ii) the city/region's long-term aspirations for measuring this indicator. This will be followed up by a 30 minute telephone interview to discuss this data in more detail.

Desk Based research to identify data sources and stakeholders:

- To identify relevant stakeholders, the research team will carry out desk-based online review of public procurement policy statements, reports, briefing notes, conference itineraries relevant to each city/region's sustainable procurement policies, as well as regional procurement agencies. Once a stakeholder has been identified, these will be evaluated for relevance according to area of responsibility and how up to date the data source is
- Initial data sources to be consulted are organisers of the Interreg EU CircPro. Project: ***https://projects2014-2020.interregeurope.eu/circpro/***
- Initial search terms to use (to be translated into official language of region using DeepL):
  - ("circular economy" OR "circular economy criteria" OR "circular criteria" OR "circular procurement") AND "public procurement" AND ("Department" OR "agency") AND ("City" OR "Region")

Input data:

- Total value of public procurement notices for the city/region (€)
- Total value of public procurement notices that stipulate CE aspects (€)

Output data:

- Share of public procurement notices that stipulate specific CE aspects. (%)

Source	Reliability*	Availability**
Municipality stakeholders	High	Medium
Open tender https://opentender.eu/es/start	Medium	Low
Eurostat	Low	Low

Table 2: Overview of key data sources

* Low = Some data will likely be missing and incomplete, which may lead to inaccurate conclusions, Medium = The data will likely be complete but may lack accuracy and quality, High = The data will likely be complete, accurate and of high quality.

** Low = The data is not already collected or readily available, and will be difficult to collect. Medium = The data is already collected but is not publicly available, OR the data is not already collected but is easy to collect, High = The data is readily available and can be accessed easily.

City / Region	Stakeholder body	Existing contact	Comment	Accessibility
All	ICLEI / Procura+		Procura+ are a network of European public authorities that connect, exchange and act on sustainable innovation procurement. They are likely to have data and/or relevant stakeholder contacts	Medium (may have contacts in public authorities of cities/regions)
All	EU GPP Helpdesk (Operated by ICLEI)		May be able to suggest potential data sources and/or stakeholders in relevant cities of study.	Medium (may have contacts in public authorities of cities/regions)
City Council of Barcelona	Mar Campanero i Sala, Sustainable City Council Programme		Listed as the contact on Procura+ for the City of Barcelona (Head of Environmental Qualification System)	Medium
	María Jose Sarrias, General Directorate of Environmental Quality Generalitat de Catalunya, Government of Catalonia		Listed as the contact on Procura+ for the Government of Catalonia (Head of Environmental Qualification System)	Medium
	Mr. Albert Olives, head of Economic Analysis of the General Directorate of Public Procurement

Mrs. María José Sarrias, head of the Environmental | | Two speakers listed at the "5th Exchange Conference on green public procurement in Catalonia" organised by the Government of Catalonia | Medium |

			Qualification Service of the General Directorate of Environmental Quality and Climate Change		
	Municipality of Nantes	Laurence Cesbron, Reseco	Yes	RESECO is a network for Public Procurement and Sustainable Development that unites communities willing to introduce social and environmental requirements in their procurement policy. They have no contacts with Paris, but do work with Nantes.	High
		Patricia Dupré-Cormerais, Nantes Metropolis		Listed as contact for the GPP In Practice issue no.74 (Sept 2017) case study: Promoting responsible purchasing in Nantes. Contact may be out of date.	Low
	City of Maribor	Regional Development Agency of Podraje Maribor		The regional development agency oversee the sustainable development of Prodrajve Maribor and its 41 component municipalities. They were responsible for development of the city's circular economy strategy, including ambitions for green-, sustainable- and circular public procurement	Low
		Igor Kos, Wycycle Institute		The WCYCLE Institute was established by the City of Maribor, with its public utility companies, as a joint platform for the development and implementation of circular economy. Igor Kos, listed as key point of contact in several online resources: circular city funding guide, Strategy for the transition to Circular Economy in the Municipality of Maribor (Regions and Cities European week, 2018)	Low

Data validation and quality control procedures	To ensure robust and high-quality results, Ricardo will conduct the following data validation and quality control procedures: • Prior to work beginning, the Project Director (Jess Twemlow) will review the proposed research methodology and ensure that the data collection plan is fit for purpose. Once the research team has addressed any comments from the review process, they will proceed to the data collection phase. • The research team will build an excel database to record relevant procurement data for the Share of public procurement notices that stipulate specific CE aspects. This will be reviewed by the Project Director prior to analysis being conducted. • The research team will present semi-structured interview guides and a list of stakeholders identified for interview to the Project Director for review prior to interviews being carried out. • Andrew Dunwoody will hold responsibility for the quality of the final case study output. Rob Snaith will assist Andrew Dunwoody in judging the quality of the output and suggesting ways to improve.
Data storage and backup procedures	Data will be stored in the Cities and Regions folder of the DG-RTD project Sharepoint. Once each file has been processed for quality control or has received substantial changes, these will be numbered and saved (e.g. v0.1, v0.2, etc) to ensure all substantive changes are appropriately recorded. During the research process, the research team will save digital copies of work being completed in their individual hard drives to prevent the loss of data.
Data security and confidentiality measures	Data will only be stored on the Ricardo SharePoint, which can only be accessed via VPN. Where data is sourced through stakeholder engagement, the research team will ensure that correct GDPR procedures are carried out and the stakeholder consents to data being used. We will ensure that all team members are trained on these issues and understand our internal procedures/policies.

5.3.3   Data collection plan for indicator CR8

Policy theme / sub-theme	*Cities and Regions*

Indicator	*Budget of public procurement notices that stipulate specific CE aspects*
URN	*CR8*

James Foss (Consultant) from Ricardo is the lead for this indicator. The below table provides an overview of the roles and responsibilities of the various stakeholders.

Name of stakeholder	Key responsibilities
Ricardo	• Ricardo will be responsible for collecting procurement data for public procurement notices that stipulate specific CE aspects for the specified city and/or region. • Once Ricardo has saturated all available data sources, Ricardo will contact relevant municipality/regional circular economy representatives to sense check findings. • Ricardo will request support from Norion and Circle Economy for support in contacting these stakeholders in Barcelona, Nantes, and Maribor.
Local municipalities	• To sense-check findings of desk-based research and to identify additional circular economy support programmes within their city/region. • To participate in stakeholder interviews if necessary.

Table 1: Overview of key responsibilities for data collection

To ensure efficiencies in the research process, data collection will be combined with indicators CR4 and CR1.

The research team will develop an initial nine question survey to be sent to each city. Three questions will request quantitative data relevant to each indicator, with a further six questions to request qualitative data on i) the city/region's challenges in monitoring this data, ii) the city/region's long-term aspirations for measuring this indicator. This will be followed up by a 30 minute telephone interview to discuss this data in more detail.

Desk Based research to identify data sources and stakeholders:

- To identify relevant stakeholders, the research team will carry out desk-based online review of public procurement policy statements, reports, briefing notes, conference itineraries relevant to each city/region's sustainable procurement policies, as well as regional procurement agencies. Once a stakeholder has been identified, these will be evaluated for relevance according to areasur of responsibility and how up to date the data source is.
- Initial search terms to use (to be translated into official language of region using DeepL):

The left column of the table contains the row labels:
Responsibilities and **Data sources**

o ("circular economy" OR "circular economy criteria" OR "circular criteria" OR "circular procurement") AND "public procurement" AND ("Department" OR "agency") AND ("City" OR "Region")

Input data:

- Total budget of public procurement notices for the city/region (€)
- Total budget of public procurement notices that stipulate CE aspects (€)

Output data:

- Total budget of public procurement notices that stipulate CE aspects (€)
- Share of public procurement notices that stipulate specific CE aspects. (%)

Source	Reliability*	Availability**
Municipality stakeholders	High	Medium
Open tender https://opentender.eu/es/start	Medium	Medium
Eurostat	Low	Low
CircPro	Medium	Medium
City of Barcleona: Guide to Sustainable Public Procurement	Medium	Low

Table 2: Overview of key data sources

* Low = Some data will likely be missing and incomplete, which may lead to inaccurate conclusions, Medium = The data will likely be complete but may lack accuracy and quality, High = The data will likely be complete, accurate and of high quality.

** Low = The data is not already collected or readily available, and will be difficult to collect. Medium = The data is already collected but is not publicly available, OR the data is not already collected but is easy to collect, High = The data is readily available and can be accessed easily.

Initial stakeholders to be contacted:

City / Region	Stakeholder body	Existing contact	Comment	Accessibility
All	ICLEI / Procura+		Procura+ are a network of European public authorities that connect, exchange and act on sustainable innovation procurement. They are likely to have data and/or relevant stakeholder contacts	Medium (may have contacts in public authorities of cities/regions)

	All	EU GPP Helpdesk (Operated by ICLEI)		May be able to suggest potential data sources and/or stakeholders in relevant cities of study.	Medium (may have contacts in public authorities of cities/regions)
	City Council of Barcelona	Mar Campanero i Sala, Sustainable City Council Programme		Listed as the contact on Procura+ for the City of Barcelona (Head of Environmental Qualification System)	Medium
		María Jose Sarrias, General Directorate of Environmental Quality Generalitat de Catalunya, Government of Catalonia		Listed as the contact on Procura+ for the Government of Catalonia (Head of Environmental Qualification System)	Medium
		Mr. Albert Olives, head of Economic Analysis of the General Directorate of Public Procurement Mrs. María José Sarrias, head of the Environmental Qualification Service of the General Directorate of Environmental Quality and Climate Change		Two speakers listed at the "5th Exchange Conference on green public procurement in Catalonia" organised by the Government of Catalonia	Medium
	Municipality of Nantes	Laurence Cesbron, Reseco		RESECO is a network for Public Procurement and Sustainable Development that unites communities willing to introduce social and environmental requirements in their procurement policy. They have no contacts with Paris, but do work with Nantes.	High

		Patricia Dupré-Cormerais, Nantes Metropolis		Listed as contact for the GPP In Practice issue no.74 (Sept 2017) case study: Promoting responsible purchasing in Nantes. Contact may be out of date.	Low
	City of Maribor	Regional Development Agency of Podraje Maribor		The regional development agency oversee the sustainable development of Prodrajve Maribor and its 41 component municipalities. They were responsible for development of the city's circular economy strategy, including ambitions for green-, sustainable- and circular public procurement	Low
		Igor Kos, Wycycle Institute		The WCYCLE Institute was established by the City of Maribor, with its public utility companies, as a joint platform for the development and implementation of circular economy. Igor Kos, listed as key point of contact in several online resources: circular city funding guide, Strategy for the transition to Circular Economy in the Municipality of Maribor (Regions and Cities European week, 2018)	Low

Data validation and quality control procedures	To ensure robust and high-quality results, Ricardo will conduct the following data validation and quality control procedures: • Prior to work beginning, the Project Director (Jess Twemlow) will review the proposed research methodology and ensure that the data collection plan is fit for purpose. Once the research team has addressed any comments from the review process, they will proceed to the data collection phase. • The research team will build an excel database to record relevant procurement data for the budget of public procurement notices that stipulate specific CE aspects. This will be reviewed by the Project Director prior to analysis being conducted. • The research team will present semi-structured interview guides and a list of stakeholders identified for interview to the Project Director for review prior to interviews being carried out.

	• Andrew Dunwoody will hold responsibility for the quality of the final case study output. Rob Snaith will assist Andrew Dunwoody in judging the quality of the output and suggesting ways to improve.
Data storage and backup procedures	Data will be stored in the Cities and Regions folder of the DG-RTD project Sharepoint. Once each file has been processed for quality control or has received substantial changes, these will be numbered and saved (e.g. v0.1, v0.2, etc) to ensure all substantive changes are appropriately recorded. During the research process, the research team will save digital copies of work being completed in their individual hard drives to prevent the loss of data.
Data security and confidentiality measures	Data will only be stored on the Ricardo SharePoint, which can only be accessed via VPN. Where data is sourced through stakeholder engagement, the research team will ensure that correct GDPR procedures are carried out and the stakeholder consents to data being used. We will ensure that all team members are trained on these issues and understand our internal procedures/policies.

5.4 ANALYSIS OF RESULTS OF WEB-SCRAPING RESULTS FOR INDICATOR CR4

Below you can find a full quantitative analysis of the results for indicator CR4.

Table 39: Analysis of the total number of expedients containing CE aspects

CPV-Code	15000000-8	18000000-9	39000000-2	44000000-0	45000000-7	50000000-5	60000000-8	71000000-8	73000000-2	Total
Total expedients	1,500	287	2,500	1,000	2,000	10,000	2,000	3,500	222	**23,009**
Total minor contracts	1,458	257	1,100	856	1,332	9,280	1,508	399	174	**16,364**
Expedients for analysis	42	30	1,400	144	668	720	492	3,101	48	**6,645**
Expedients meeting CE aspects	6	8	5	4	64	32	6	29	9	**163**
Share of expedients meeting CE aspects (by number)	**14.29%**	**26.67%**	**0.36%**	**2.78%**	**9.58%**	**4.44%**	**1.22%**	**0.94%**	**18.75%**	**2.45%**

Table 40: Analysis of the total value of expedients containing specific CE aspects

CPV-Code	15000000-8	18000000-9	39000000-2	44000000-0	45000000-7	50000000-5	60000000-8	71000000-8	73000000-2	Total
Total expedients	62,188,721.13 €	4,010,745.12 €	4,344,367.85 €	1,873,491.72 €	316,887,335.80 €	149,338,035.65 €	3,619,155.71 €	69,356,202.67 €	14,262,219.36 €	**625,880,275.01 €**
Total minor contracts	900,438.84 €	294,058.77 €	1,949,323.95 €	922,393.00 €	15,934,915.40 €	12,568,442.05 €	824,724.88 €	2,269,051.82 €	569,307.09 €	**36,232,655.80 €**
Expedients for analysis	61,288,282.29 €	3,716,686.35 €	2,395,043.90 €	951,098.72 €	300,952,420.40 €	136,769,593.60 €	2,794,430.83 €	67,087,150.85 €	13,692,912.27 €	**589,647,619.21 €**
Expedients meeting CE aspects	12,641,453.66 €	612,737.87 €	181,113.92 €	92,959.46 €	21,299,604.78 €	5,560,924.66 €	506,895.00 €	7,433,596.15 €	654,070.91 €	**48,983,356.41 €**
Share of expedients meeting CE aspects (by value)	**20.63%**	**16.49%**	**7.56%**	**9.77%**	**7.08%**	**4.07%**	**18.14%**	**11.08%**	**4.78%**	**8.31%**

5.5 ANALYSIS OF RESULTS OF WEB-SCRAPING FOR INDICATOR CR8

Table 41: Total number of expedients identified containing CE aspects

CPV-Code	15000000-8	18000000-9	39000000-2	44000000-0	45000000-7	50000000-5	60000000-8	71000000-8	73000000-2	Total
Total expedients	1,500	287	2,500	1,000	2,000	10,000	2,000	3,500	222	**23,009**
Total minor contracts	1,458	257	1,100	856	1,332	9,280	1,508	399	174	**16,364**
Expedients for analysis	42	30	1,400	144	668	720	492	3,101	48	**6,645**
Expedients meeting CE aspects	6	8	5	4	64	32	6	29	9	**163**
Share of expedients meeting CE aspects (by number)	**14.29%**	**26.67%**	**0.36%**	**2.78%**	**9.58%**	**4.44%**	**1.22%**	**0.94%**	**18.75%**	**2.45%**

Table 42: Analysis of the total and average value of expedients containing CE aspects

CPV-Code	15000000-8	18000000-9	39000000-2	44000000-0	45000000-7	50000000-5	60000000-8	71000000-8	73000000-2	Total Value
Total value of expedients without CE aspects	€ 48,646,828.63	€ 3,103,948.48	€ 2,213,929.98	€ 858,139.26	€ 279,652,815.62	€ 131,208,668.94	€ 2,287,535.83	€ 59,653,554.70	€ 13,038,841.36	**€ 540,664,262.80**
Total number of notices without CE aspects	36	22	1395	140	604	688	486	3072	39	**6482**
Total value of notices containing CE aspects	€ 12,641,453.66	€ 612,737.87	€ 181,113.92	€ 92,959.46	€ 21,299,604.78	€ 5,560,924.66	€ 506,895.00	€ 7,433,596.15	€ 654,070.91	**€ 48,983,356.41**
Total number of notices containing CE aspects	6	8	5	4	64	32	6	29	9	**163**
Average value of notices without CE aspects	€ 1,351,300.80	€ 141,088.57	€ 1,587.05	€ 6,129.57	€ 463,001.35	€ 190,710.27	€ 4,706.86	€ 19,418.47	€ 334,329.27	**€ 83,410.10**

CPV-Code	15000000-8	18000000-9	39000000-2	44000000-0	45000000-7	50000000-5	60000000-8	71000000-8	73000000-2	Total Value
Average value of notices containing CE aspects	€ 2,106,908.94	€ 76,592.23	€ 36,222.78	€ 23,239.87	€ 332,806.32	€ 173,778.90	€ 84,482.50	€ 256,330.90	€ 72,674.55	**€ 300,511.39**
Difference in value between notices containing CE and non-CE aspects	€ 755,608.15	- € 64,496.33	€ 34,635.74	€ 17,110.30	- € 130,195.03	- € 16,931.38	€ 79,775.64	€ 236,912.43	- € 261,654.72	**€ 217,101.29**
Difference as a percentage	156%	54%	2282%	379%	72%	91%	1795%	1320%	22%	**360%**

5.6   WEB-SCRAPING SCRIPTS

Below you can find the web-scraping scripts used for the analysis of indicators CR1, CR4, and CR8.

Table 43: Web-scraping scripts during analysis of indicators CR1, CR4, and CR8

Web-scraping scripts
04_scrapper_ALL_CPV

```
# Imports
import pathlib
import shutil
from pathlib import Path
from selenium import webdriver
from selenium.webdriver.support.ui import WebDriverWait
from selenium.webdriver.common.action_chains import ActionChains
from selenium.webdriver.support import expected_conditions as EC
from selenium.webdriver.common.by import By
from selenium.webdriver.common.keys import Keys
from selenium.common.exceptions import NoSuchElementException, TimeoutException, ElementClickInterceptedException,
StaleElementReferenceException
from selenium.webdriver.chrome.service import Service


from selenium.webdriver.support.ui import Select


import openpyxl
import requests
import os
import json
import time
from bs4 import BeautifulSoup
import pandas as pd


import warnings
warnings.filterwarnings("ignore", category=DeprecationWarning, module="pandas")
# Suppress openpyxl UserWarning
warnings.filterwarnings("ignore", category=UserWarning, module="openpyxl")


# Automatically reload modules before executing Python code
%reload_ext autoreload
%autoreload 2


root_dir = pathlib.Path().resolve().parent
data_dir = root_dir / "data"
download_dir = str(data_dir / "download")
base_download_path = data_dir / "download"
try:
    os.makedirs(download_dir)
except:
    pass
chrome_options = webdriver.ChromeOptions()
settings = {
```

Web-scraping scripts

```
    "recentDestinations": [{
        "id": "Save as PDF",
        "origin": "local",
        "account": "",
    }],
    "selectedDestinationId": "Save as PDF",
    "version": 2
  }
prefs = {'download.default_directory' : download_dir,
        'savefile.default_directory': download_dir,
        'printing.print_preview_sticky_settings.appState': json.dumps(settings)}


chrome_options.add_experimental_option('prefs', prefs)
chrome_options.add_argument('--kiosk-printing')


chrome_options.binary_location = (os.path.expanduser("~") + r"\chrome-win64\chrome.exe")
ChromeDriverService = Service(os.path.expanduser("~") + r"\chromedriver.exe")
driver = webdriver.Chrome(service=ChromeDriverService, options=chrome_options)


# ## CPV Codes
FWN2 = [
    "15000000-8",
    "15100000-9",
    "15200000-0",
    "15300000-1",
    "15400000-2",
    "15500000-3",
    "15600000-4",
    "15700000-5",
    "15800000-6",
    "15900000-7"]
CR1 = [
    "35800000-2",
    "18000000-9"]
CR4_CR8 = ['15000000-8',
    '18000000-9',
    '35800000-2',
    '39000000-2',
    '44000000-0',
    '45000000-7',
    '50000000-5',
    '60000000-8',
    '71000000-8',
    '73000000-2',
    '90000000-7']
ind_cpv_dict = {
    "FWN2" : [
    "15000000-8",
    "15100000-9",
    "15200000-0",
    "15300000-1",
```

Web-scraping scripts

```python
    "15400000-2",
    "15500000-3",
    "15600000-4",
    "15700000-5",
    "15800000-6",
    "15900000-7"],
    "CR1" : [
    "35800000-2",
    "18000000-9"],
    "CR4_CR8" : ['15000000-8',
      '18000000-9',
      '35800000-2',
      '39000000-2',
      '44000000-0',
      '45000000-7',
      '50000000-5',
      '60000000-8',
      '71000000-8',
      '73000000-2',
      '90000000-7'],
}


for list_name, cpv_codes in ind_cpv_dict.items():
    # Create a directory for the list
    list_directory_path = base_download_path / list_name
    list_directory_path.mkdir(parents=True, exist_ok=True)


    # For each CPV code in the list, create a sub-directory within the list's directory
    for cpv_code in cpv_codes:
        cpv_directory_path = list_directory_path / cpv_code
        cpv_directory_path.mkdir(exist_ok=True)
# ## Load platform search homepage and accept T&Cs/Cookies

#Load platform homepage and accept T&Cs/Cookies
driver.get(r"https://contractaciopublica.cat/en/cerca-
avancada?page=0&inclourePublicacionsPlacsp=false&sortField=dataUltimaPublicacio&sortOrder=desc")

# Target the 'Accept them all' button using the ngbautofocus attribute
accept_button_selector = "button[ngbautofocus][class='btn btn-primary']"

# Scroll into view using JavaScript and then attempt to click
button = WebDriverWait(driver, 20).until(EC.element_to_be_clickable((By.CSS_SELECTOR, accept_button_selector)))
driver.execute_script("arguments[0].scrollIntoView(true);", button)
time.sleep(2)  # Adding a brief delay to ensure any animations/overlays have settled

try:
    # Attempt to click using Selenium
    button.click()
except Exception as e:
    # If normal click fails, use JavaScript click as a fallback
    driver.execute_script("arguments[0].click();", button)
```

Web-scraping scripts

```python
# input CPV codes


# Step 1: Click the dropdown to open it
dropdown = WebDriverWait(driver, 20).until(
    EC.element_to_be_clickable((By.CSS_SELECTOR, "ng-select[formcontrolname='dataUltimaPublicacio'] .ng-select-container"))
)
# Scroll the dropdown into view
driver.execute_script("arguments[0].scrollIntoView(true);", dropdown)
time.sleep(1)
dropdown.click()


# Step 2: Wait for the "Interval" option to appear and click it
# Since the options are appended to the body, we use a more global selector.
# Adjust the selector based on the actual rendered options. This might require inspecting the opened dropdown.
interval_option = WebDriverWait(driver, 20).until(
    EC.element_to_be_clickable((By.XPATH, "//div[contains(@class, 'ng-option') and contains(., 'Interval')]"))
)
interval_option.click()


# Assuming the driver is already initialized and navigated to the relevant page
start_date = "01/01/2023"  # Adjust the date format as needed
end_date = "31/12/2023"  # Adjust the date format as needed


# Locate the input field for the start date
start_date_input = WebDriverWait(driver, 20).until(
    EC.element_to_be_clickable((By.ID, "ca-data-ultima-publicacio-inici"))
)


# Clear the input field before entering the new date, if necessary
start_date_input.clear()


# Enter the start date
start_date_input.send_keys(start_date)

end_date_input = WebDriverWait(driver, 20).until(
    EC.element_to_be_clickable((By.ID, "ca-data-ultima-publicacio-fi"))
)
end_date_input.clear()
end_date_input.send_keys(end_date)



def retry_scroll_and_click(driver, button_locator, max_attempts=5):
    attempts = 0
    while attempts < max_attempts:
        try:
            # Wait for the button to be clickable
            apply_filters_button = WebDriverWait(driver, 10).until(
                EC.element_to_be_clickable(button_locator)
            )
            # Scroll the button into view
            driver.execute_script("arguments[0].scrollIntoView(true);", apply_filters_button)
```

Web-scraping scripts

```
            time.sleep(0.5)  # Slight delay to ensure scroll effect completes
            # Attempt to click the button
            apply_filters_button.click()
            print("SUCCESS!!!")
            return  # If the click succeeds, exit the function
        except (ElementClickInterceptedException, TimeoutException) as e:
            print(f"Attempt {attempts + 1} failed: {e}")
            time.sleep(1)  # Wait a bit before retrying
            attempts += 1
    print("Max attempts reached, unable to click the apply filters button.")


from ipywidgets import interact
import ipywidgets as widgets


def get_list_and_code(list_name, cpv_code):
    return list_name, cpv_code


# <a id='start_run'></a>



# Define the interactive widget
list_widget = widgets.Dropdown(options=ind_cpv_dict.keys(), description='List Name:')
code_widget = widgets.Dropdown(options=ind_cpv_dict.get(list_widget.value), description='CPV Code:')
output = interact(get_list_and_code, list_name=list_widget, cpv_code=code_widget)


# Define a function to update the cpv_code options based on the selected list_name
def update_cpv_code_options(change):
    selected_list = change.new
    if selected_list:
        code_widget.options = ind_cpv_dict[selected_list]


# Attach the function to the list_name dropdown's observe method
list_widget.observe(update_cpv_code_options, names='value')


# Assign the output to list_name and cpv_code variables
list_name, cpv_code = output.widget.result


# ## Semiautomatic option

list_name
cpv_code
print(f"Working on {list_name}, CPV {cpv_code}")

try:
    # Wait for the clear button to be clickable
    clear_button = WebDriverWait(driver, 10).until(
        EC.element_to_be_clickable((By.CSS_SELECTOR, ".ng-clear-wrapper"))
    )
    # Click the clear button to clear the field
    print("SUCCESS!!")
    clear_button.click()
```

Web-scraping scripts

```
except NoSuchElementException:
    print("Clear button not found.")
except Exception as e:
    print(f"An error occurred: {e}")
# Wait for the CPV input field to be clickable and click it to ensure it's focused
cpv_input_xpath = "//ng-select[@formcontrolname='cpv']//input"

cpv_input = WebDriverWait(driver, 20).until(
    EC.element_to_be_clickable((By.XPATH, cpv_input_xpath))
)

# cpv_input.clear()
cpv_input.click()
cpv_input.send_keys(cpv_code)
cpv_input.send_keys(Keys.ENTER)
# # Locate the "Apply filters" button by its class attributes
# apply_filters_button = WebDriverWait(driver, 30).until(
#     EC.element_to_be_clickable((By.CSS_SELECTOR, "button.btn.btn-primary.w-100"))
# )
button_locator = (By.CSS_SELECTOR, "button.btn.btn-primary.w-100")
retry_scroll_and_click(driver, button_locator)
# driver.execute_script("arguments[0].scrollIntoView(true);", apply_filters_button)
# apply_filters_button.click()
# Find the dropdown by its ID
dropdown = Select(driver.find_element(By.ID, "pagines-exportacio-excel"))
# Extract all options within the dropdown
options = dropdown.options
# Store the visible text of each option in a list
option_texts = [option.text for option in options]
print(option_texts)
print(len(option_texts))
# for option_text in option_texts:
#     # Select the option by its visible text
#     dropdown.select_by_visible_text(option_text)
#     # Find and click the "Download" button
#     download_button = WebDriverWait(driver, 10).until(
#         EC.element_to_be_clickable((By.CSS_SELECTOR, "button.btn.btn-sm.btn-green"))
#     )
#     download_button.click()

#     # Wait for the download to initiate/start or for the page to reload, if necessary
#     # You might need to add a delay or wait for a specific condition here

#     # If the page reloads after each download, you'll need to re-locate the dropdown and create a new Select object
#     # dropdown = Select(driver.find_element(By.ID, "pagines-exportacio-excel"))


# automatic retry

for option_text in option_texts:
    # The maximum number of retry attempts
```

Web-scraping scripts

```
    max_attempts = 5

    # The delay between retry attempts
    retry_delay = 2  # seconds

    # Initialize an attempt counter
    attempts = 0

    # Element selector
    selector = "button.btn.btn-sm.btn-green"

    while attempts < max_attempts:
        try:
            # Wait for the download button to be clickable
            download_button = WebDriverWait(driver, 10).until(
                EC.element_to_be_clickable((By.CSS_SELECTOR, selector))
            )

            # Scroll into view and click the download button
            driver.execute_script("arguments[0].scrollIntoView(true);", download_button)
            download_button.click()

            # If click is successful, exit the loop
            print("SUCCESS!!!")
            break
        except ElementClickInterceptedException as e:
            # If the click fails, print an error message, increment the attempt counter, and wait before retrying
            print(f"Attempt {attempts + 1} failed: {str(e)}")
            attempts += 1
            time.sleep(retry_delay)
        except TimeoutException as e:
            # If the button is not found within the wait period
            print(f"Button not found after {attempts + 1} attempts: {str(e)}")
            break

    if attempts == max_attempts:
        # Handle the case where all retry attempts failed
        print("Failed to click the download button after maximum attempts.")
        # Implement any error handling or fallback logic here

# Initialize an empty DataFrame to store the merged data
merged_data = pd.DataFrame()

# Initialize an empty list to store DataFrames
dfs = []

# Loop through each file in the folder
for filename in os.listdir(download_dir):
    if filename.endswith(".xlsx"):
        file_path = os.path.join(download_dir, filename)
```

Web-scraping scripts

```python
    # Read each Excel file into a DataFrame and append it to the list
    df = pd.read_excel(file_path)
    dfs.append(df)


# Concatenate the list of DataFrames into a single DataFrame
merged_data = pd.concat(dfs, ignore_index=True)


# add columns for indicator group and cpv code
merged_data['indicator'] = list_name
merged_data['cpv'] = cpv_code


# Specify the path and filename for the merged Excel file
output_file = "merged_data.xlsx"


# Write the merged data to a new Excel file
merged_data.to_excel(Path(download_dir) / output_file, index=False)


print(f'Merged data saved to {output_file}')


# construct folder to move merged xlsx
path_to_move = base_download_path / list_name / cpv_code


# List all files in the base download directory, excluding directories
downloaded_files = [item for item in base_download_path.glob("*") if item.is_file()]


# Move each file to the CPV directory
for file_path in downloaded_files:
    # Construct the destination path with the same filename in the CPV directory
    destination_path = path_to_move / file_path.name

    # Move the file
    shutil.move(str(file_path), str(destination_path))

    print(f"Moved file {file_path.name} to {destination_path}")



# [Start run](#start_run)


# ## END LOGIC
driver.close()
```

06_pdf-analysis

```python
# Imports
import pathlib
import matplotlib.pyplot as plt
import shutil
from pathlib import Path
import openpyxl
import os
import json
import time
```

Web-scraping scripts

```python
import pandas as pd
import fitz
from tqdm import tqdm

from fuzzywuzzy import process
from fuzzywuzzy import fuzz

import warnings
warnings.filterwarnings("ignore", category=DeprecationWarning, module="pandas")
# Filter out the specific DeprecationWarning about PyArrow dependency
warnings.filterwarnings(action='ignore', category=DeprecationWarning, message='.*PyArrow will become a required dependency.*')
warnings.filterwarnings("ignore", category=DeprecationWarning)
# Suppress openpyxl UserWarning
warnings.filterwarnings("ignore", category=UserWarning, module="openpyxl")

# Automatically reload modules before executing Python code
%reload_ext autoreload
%autoreload 2

root_dir = pathlib.Path().resolve().parent
data_dir = root_dir / "data"
out_dir = data_dir / "output"
download_dir = str(data_dir / "download")
base_download_path = data_dir / "download"
try:
    os.makedirs(download_dir)
except:
    pass
def count_pdf_files(directory_path):
    """Count the number of PDF files in the directory and its subdirectories."""
    root_path = Path(directory_path)
    pdf_count = sum(1 for _ in root_path.rglob('*.pdf'))
    return pdf_count

number_of_pdfs = count_pdf_files(base_download_path)
print(f"Total number of PDF files: {number_of_pdfs}")

def count_files_in_4th_level_folders(root_dir):
    for root, dirs, files in os.walk(root_dir):
        # Split the path to check the depth
        path_parts = root.split(os.sep)
        if len(path_parts) == 5:  # Adjust the number based on root depth
            print(f"{path_parts[-1]}: {len(files)} files")

count_files_in_4th_level_folders(download_dir)

from collections import defaultdict
import os

def create_dataframe_of_files_at_10th_level(root_dir):
    # Prepare a list to hold file information
```

Web-scraping scripts

```python
file_data = []

for root, dirs, files in os.walk(root_dir):
    path_parts = root.split(os.sep)
    if len(path_parts) == 10:  # Adjust for 10th level
        for file in files:
            # Extract file information
            file_path = os.path.join(root, file)
            print(file_path)
            extension = os.path.splitext(file)[1]
            tender = file_path.split("\\")[-2]
            print(tender)
            file_data.append({
                'File Path': file_path,
                'Tender' : tender,
                'File Name': file,
                'Extension': extension
            })

    # Convert the list of dictionaries to a DataFrame
    df_files = pd.DataFrame(file_data)
    return df_files

output = create_dataframe_of_files_at_10th_level(download_dir)

output.to_excel(out_dir / "pdf_report.xlsx", index=False)

# Group by 'Tender' and count the number of PDFs for each tender
tender_pdf_count = output[output['Extension'] == '.pdf'].groupby('Tender').size()

# Filter to get only tenders with exactly one PDF
tenders_with_single_pdf = tender_pdf_count[tender_pdf_count == 1]

# Create a DataFrame from the filtered series
df_tenders_with_single_pdf = pd.DataFrame(tenders_with_single_pdf, columns=['PDF Count'])

# Display the DataFrame with tenders that have only one PDF
df_tenders_with_single_pdf.reset_index(inplace=True)  # Reset index to turn 'Tender' back into a column
df_tenders_with_single_pdf

# ## CPV Codes

FWN2 = [
    "15000000-8",
    "15100000-9",
    "15200000-0",
    "15300000-1",
    "15400000-2",
    "15500000-3",
    "15600000-4",
    "15700000-5",
```

Web-scraping scripts

```python
    "15800000-6",
    "15900000-7"]


CR1 = [
    "35800000-2",
    "18000000-9"]


CR4_CR8 = ['15000000-8',
    '18000000-9',
    '35800000-2',
    '39000000-2',
    '44000000-0',
    '45000000-7',
    '50000000-5',
    '60000000-8',
    '71000000-8',
    '73000000-2',
    '90000000-7']


ind_cpv_dict = {
    "FWN2" : [
    "15000000-8",
    "15100000-9",
    "15200000-0",
    "15300000-1",
    "15400000-2",
    "15500000-3",
    "15600000-4",
    "15700000-5",
    "15800000-6",
    "15900000-7"],
    "CR1" : [
    "35800000-2",
    "18000000-9"],
    "CR4_CR8" : [
        '15000000-8',
        '18000000-9',
        '35800000-2',
        '39000000-2',
        '44000000-0',
        '45000000-7',
        '50000000-5',
        '60000000-8',
        '71000000-8',
        '73000000-2',
            ],
}

def search_keywords_in_pdf(pdf_path, keywords):
    """Search for keywords in a given PDF and return a list of pages and keywords found."""
    results = []
```

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```python
    doc = fitz.open(pdf_path)
    for page_num in range(len(doc)):
        page_text = doc[page_num].get_text().lower()  # Convert page text to lower case for case-insensitive search
        for keyword in keywords:
            if keyword.lower() in page_text:
                results.append((page_num + 1, keyword))  # Adding 1 to make it human-readable
    doc.close()
    return results


def search_keywords_fuzzy_in_pdf(pdf_path, keywords, threshold=95):
    """Search for keywords in a given PDF with fuzzy matching and return a list of pages and keywords found."""
    results = []
    doc = fitz.open(pdf_path)
    for page_num in range(len(doc)):
        page_text = doc[page_num].get_text().lower()
        for keyword in keywords:
            match, score = process.extractOne(keyword.lower(), [page_text], scorer=fuzz.token_set_ratio)
            if score > threshold:  # Only consider matches above the threshold
                results.append((page_num + 1, keyword))  # Adding 1 to make it human-readable
    doc.close()
    return results


def extract_path_info(pdf_path):
    """Extract indicator, CPV, and expedient number from the PDF path."""
    parts = pdf_path.parts
    download_index = parts.index('download')
    indicator, cpv, expedient_number = parts[download_index + 1], parts[download_index + 2], parts[download_index + 3]
    return indicator, cpv, expedient_number


def search_in_folder_structure(root_folder, keywords):
    """Search through the folder structure for PDFs and keywords, compiling the results into a DataFrame."""
    data = []
    root_path = Path(root_folder)
    pdf_files = list(root_path.rglob('*.pdf'))  # List of all PDF files
    for pdf_path in tqdm(pdf_files, desc="Processing PDFs"):  # Wrap with tqdm for progress bar
        found_keywords = search_keywords_in_pdf(pdf_path, keywords)
        indicator, cpv, expedient_number = extract_path_info(pdf_path)
        for page_num, keyword in found_keywords:
            data.append({
                "PDF Path": str(pdf_path),
                "Page": page_num,
                "Keyword": keyword,
                "Indicator": indicator,
                "CPV": cpv,
                "Expedient Number": expedient_number
            })

    return pd.DataFrame(data)


def search_in_folder_structure_per_indicator(root_folder, keywords, keyword_list_mapping):
    """Search through the folder structure for PDFs and keywords, compiling the results into a DataFrame."""
```

Web-scraping scripts

```python
    data = []
    root_path = Path(root_folder)
    pdf_files = list(root_path.rglob('*.pdf'))  # List of all PDF files
    for pdf_path in tqdm(pdf_files, desc="Processing PDFs"):  # Wrap with tqdm for progress bar
        found_keywords = search_keywords_in_pdf(pdf_path, keywords)
        indicator, cpv, expedient_number = extract_path_info(pdf_path)
        for page_num, keyword in found_keywords:
            keyword_list = keyword_list_mapping.get(keyword, 'Unknown')  # Get the keyword list name or 'Unknown'
            if keyword_list == indicator:
                data.append({
                    "PDF Path": str(pdf_path),
                    "Page": page_num,
                    "Keyword": keyword,
                    "Keyword List": keyword_list,  # Include the keyword list name
                    "Indicator": indicator,
                    "CPV": cpv,
                    "Expedient Number": expedient_number
                })

    return pd.DataFrame(data)


def search_in_folder_structure_fuzzy(root_folder, keywords):
    """Search through the folder structure for PDFs and keywords, compiling the results into a DataFrame."""
    data = []
    root_path = Path(root_folder)
    pdf_files = list(root_path.rglob('*.pdf'))  # List of all PDF files
    for pdf_path in tqdm(pdf_files, desc="Processing PDFs"):  # Wrap with tqdm for progress bar
        found_keywords = search_keywords_fuzzy_in_pdf(pdf_path, keywords)
        indicator, cpv, expedient_number = extract_path_info(pdf_path)
        for page_num, keyword in found_keywords:
            data.append({
                "PDF Path": str(pdf_path),
                "Page": page_num,
                "Keyword": keyword,
                "Indicator": indicator,
                "CPV": cpv,
                "Expedient Number": expedient_number
            })

    return pd.DataFrame(data)
def search_in_folder_structure_fuzzy_per_indicator(root_folder, keywords, keyword_list_mapping):
    """Search through the folder structure for PDFs and keywords with fuzzy matching, compiling the results into a DataFrame."""
    data = []
    root_path = Path(root_folder)
    pdf_files = list(root_path.rglob('*.pdf'))  # List of all PDF files
    for pdf_path in tqdm(pdf_files, desc="Processing PDFs"):  # Wrap with tqdm for progress bar
        found_keywords = search_keywords_fuzzy_in_pdf(pdf_path, keywords)
        indicator, cpv, expedient_number = extract_path_info(pdf_path)
        for page_num, keyword in found_keywords:
            keyword_list = keyword_list_mapping.get(keyword, 'Unknown')  # Get the keyword list name or 'Unknown'
            if keyword_list == indicator:
```

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```python
        data.append({
            "PDF Path": str(pdf_path),
            "Page": page_num,
            "Keyword": keyword,
            "Keyword List": keyword_list,  # Include the keyword list name
            "Indicator": indicator,
            "CPV": cpv,
            "Expedient Number": expedient_number
        })


    return pd.DataFrame(data)
keywords = [
    "Reglament (CE) 2018/848",
    "ecològic",
    "ecològica",
    "ecològics",
    "ecològiques",
    "productes alimentaris ecològics",
    "productes ecològics",
    "fonts ecològiques",
    "activitats agrícoles ecològiques",
    "requisits ecològics",
    "etiqueta ecològica",
    "etiquetatge ecològic",
    "criteris de producció ecològica",
    "Reglament 2018/848",
    "CE 2018/848"
]


CR1_keywords = [
    "etiqueta ecològica", "Segells tèxtils ecològics",
    "Consum d'energia", "cotó ecològic",
    "sistema de recollida i millores aplicades", "sistema de recollida",
    "separació i la classificació dels productes tèxtils", "separació després de la recollida",
    "maximitzar el valor obtingut de la reutilització o el reciclatge",
    "minimitzen l'ús d'energia",
    "Rentat a baixa temperatura",
    "polièster reciclat", "material reciclat",
    "Disseny per al reciclatge de polièster",
    "la llista de substàncies candidates REACH",
    "Absència o limitació de contaminants", "REACH", "article 33, apartat 2, de REACH",
    "llista de substàncies candidates de REACH",
    "gestió integrada de plagues (GIP)",
    "Durabilitat del producte", "reciclatge",
    "Disponibilitat d'accessoris o parts", "Manteniment", "Allargar al màxim la via útil",
    "prestació de reparacions", "substitució de peces trencades", "substitució de peces perdudes",
    "serveis per reparar",
    "Disseny per a la reutilització i el reciclatge", "la reutilització", "contingut reciclat mínim",
    "matèries primeres reciclades", "certificació de tercers del contingut reciclat",
    "sistema de gestió ambiental", "ISO 14001", "EMAS", "Origen de les fibres tèxtils",
    "traçabilitat de l'origen", "Gestió de productes químics", "sistemes de conformitat",
```

Web-scraping scripts

```
    "sistema de conformitat", "sistemes de certificació", "sistema de certficació", "Ecològic",
    "contingut en cotó ecològic", "contingut en fibres de cotó ecològic",
    "certificats ecològics", "OEKO-TEX", "GOTS", "Global Organic Textile Standard",
    "toxicitat aquàtica", "biodegradabilitat"
]


CR4_CR8_keywords = [
    "Reduir la quantitat total de materials", "lloguer", "Lloguer", "Arrendament", "arrendament",
    "Reutilitzar", "reformar-", "Actualitza", "Ús mínim de materials", "Minimitzar l'ús de materials",
    "Menys residus", "Eficiència dels recursos", "Reduir els residus", "Prevenir els residus",
    "Pla de gestió de residus", "Pla de reducció de residus", "Reduir la quantitat d'inputs verges",
    "Quota de materials reciclats", "Part de contingut reciclat", "Part de materials de base biològica",
    "Part de contingut de base biològica", "Materials/contingut reciclats", "Materials/contingut de base biològica",
    "allargar la vida útil", "Acords de Manteniment", "Acords de reparació", "Servei de manteniment",
    "Servei de reparació", "producte actualitzable", "Actualització", "Disseny per a la longevitat",
    "Disseny per a la durabilitat", "Durabilitat", "Reparabilitat", "Mantenibilitat", "Disseny modular",
    "allargament de la vida útil del producte", "Ampliació de la vida útil", "Ampliar la vida útil funcional",
    "Orientació del proveïdor per a l'optimització d'ús", "Orientació per al manteniment del producte",
    "Maximitzar la reutilització d'un producte o component", "Disseny per al desmuntatge", "Disseny estandarditzat",
    "Esquema/sistema de recuperació", "Esquema/sistema de recuperació i reutilització", "Models de negoci circulars",
    "Models de negoci d'economia circular", "Maximitzar la reutilització dels materials", "Disseny per al reciclatge",
    "Acords contractuals de recuperació i reciclatge", "Servei de recuperació i reciclatge", "Recollida per al reciclatge",
    "Reduir la toxicitat", "Substàncies químiques restringides", "Degradable biològicament", "Biològicament compostable",
    "Biodegradable", "Compostable"
]


FWN2_keywords = [
    "Serveis de menjar i àpats",
    "Ecològic",
    "Orgànica",
    "Producció ecològica",
    "Productes ecològics",
    "Reglament (UE) 2018/848",
    "Reglament (UE) 834/2007",
    "ecològic de la UE",
    "Consell Català de la Producció Agrària Ecològica (CCPAE)"
]


# Mapping keywords to their respective lists for easy lookup
keyword_list_mapping = {keyword: 'CR1' for keyword in CR1_keywords}
keyword_list_mapping.update({keyword: 'CR4_CR8' for keyword in CR4_CR8_keywords})
keyword_list_mapping.update({keyword: 'FWN2' for keyword in FWN2_keywords})


keyword_list_mapping


# Combine all keywords from CR1, CR4_CR8, FWN2 into a single set for searching
all_keywords = set(CR1_keywords + CR4_CR8_keywords + FWN2_keywords)
# search with indicators output
results_df = search_in_folder_structure_per_indicator(base_download_path, all_keywords, keyword_list_mapping)
# normal search
results_df = search_in_folder_structure(base_download_path, keywords)
```

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```
# fuzzy search
results_fuzzy_df = search_in_folder_structure_fuzzy_per_indicator(base_download_path, all_keywords, keyword_list_mapping)


results_df


results_fuzzy_df


results_df.to_excel(out_dir / "keywords_per_indicator_filtered.xlsx", index=False)


results_fuzzy_df.to_excel(out_dir / "keywords_per_indicator_fuzzy.xlsx", index=False)
```

5.7   RACER MATRIX USED TO ASSESS CR1, CR4 AND CR8

Criterion	Description	1 (Poor)	2 (Neutral)	3 (Good)
Relevance	Refers to whether the indicator is closely linked to the objectives to be reached.	Does not support a better understanding of true circularity.	Supports a better understanding of true circularity.	Highly supportive towards gaining a better understanding of true circularity.
		Supports no value-added circular opportunities.	Supports lower value-added opportunities (i.e. metrics related to waste generation, recycling, waste management, etc.)	Supports higher value-added opportunities (i.e. all R-strategies above remanufacturing) and wider systemic change (e.g. indicators that encourage PSS or circular design).
		Not linked to the project objectives and/or European policy objectives (existing or upcoming).	Linked to the project objectives, but not to European policy objectives (existing and/or upcoming).	Fully aligned with project objectives and European policy objectives (existing and/or upcoming).
Acceptance	Refers to whether the indicator is perceived and used by key stakeholders (such as policymakers, civil society, and industry).	Poorly accepted by key stakeholders, e.g. due to the use of confidential data.	Relatively accepted by key stakeholders as the benefits of measuring are clear.	Key stakeholders are motived to report this indicator, due to mandatory legislative requirements (current or upcoming), potential commercial benefit or being in the public interest.
Credibility	Refers to whether the indicator is transparent, trustworthy and easy to interpret.	No defined methodology associated with this indicator and/or interpretation of the indicator is ambiguous.	Methodologies have been proposed or currently existing, but not for this particular indicator (e.g. in a research article).	There is an EU defined methodology.
		Difficult to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are not familiar with).	Moderately easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are aware of but are not confident in practical use).	Easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders already use and are confident in applying).
Ease	Refers to the easiness of measuring and monitoring the indicator.	No defined methodology associated with this indicator and/or interpretation of the indicator is ambiguous.	Methodologies have been proposed or currently existing, but not for this particular indicator (e.g. in a research article).	There is an EU defined methodology.
		Difficult to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are not familiar with).	Moderately easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are aware of but are not confident in practical use).	Easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders already use and are confident in applying).
Robustness	Refers to whether data is biased and comprehensively assesses circularity.	No consistent methodology and dataset are available.	A consistent methodology and dataset available.	A consistent methodology and dataset available.
			A composite/aggregated indicator (based on multiples dimensions).	A one-dimensional indicator.
			A proxy indicator.	

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