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Co-development of a framework for circular economy assessment in organisations: Learnings from the public sector

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Abstract

To seize the potential of Circular Economy (CE) organisations need to evaluate and communicate their progress moving away from the non-sustainable paradigm of 'take-make-dispose' towards circularity. Existing CE assessments for organisations focus on companies. Although the need for CE assessment is recognised in both public and private sectors, little progress has been made towards developing an approach for public sector organisations. CE assessment in public sector organisations is particularly important due to their role model, agenda setting and economic function. Therefore, this article co-develops a CE assessment framework for public sector organisations. Portuguese public sector organisations were involved as a participatory case study. The result is a framework that covers the following components: (i) a system definition; (ii) a definition of 35 CE assessment elements; (iii) CE assessment targets; and (iv) CE indicators. The framework contributes to the understanding of circularity from a public sector perspective considering three key aspects: resources, operations and processes as well as social and employee related activities. Implications for CE assessments in the public and private sector encompass the importance for an early involvement of stakeholders to get a sector specific perspective, the need to address user-friendliness and the requirement for continuous testing of CE assessments.

KEYWORDS
assessment, circular economy, indicators, public administration, stakeholder engagement, sustainable development

1 | INTRODUCTION

To seize more potential of Circular Economy (CE) organisations need to include CE assessment in their operations and processes (Prieto-Sandoval et al., 2019). Especially in the last five years, sustainability literature has been captivated by the CE concept (Daddi et al., 2019). CE is presented as one key strategy to achieve sustainable development (Schroeder et al., 2018). Kirchherr et al. (2017) define CE 'as an economic system that replaces the "end-of-life" concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes (...) with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations' (p. 229). CE targets three levels: the macro level of policies and regulations, the meso-level of industrial networks and the micro level of organisations,

products and materials (Kirchherr et al., 2017). However, there is no agreement on what exactly the CE concept entails (Korhonen et al., 2018). According to the Ellen MacArthur Foundation (2015) CE is considered to be an umbrella concept departing from schools of thought, like Industrial Ecology (Frosch & Gallopoulos, 1989; Graedel & Allenby, 1995), Regenerative Design (Lyle, 1994), Cradle to Cradle (Braungart & McDonough, 2002), Biomimicry (Benyus, 2003), Looped and Performance Economy (Stahel, 2006) or the Blue Economy (Pauli, 2010). Authors in CE literature often include learnings from these schools to facilitate an integrated and systemic CE implementation (Mendoza et al., 2017).

Organisations are a semi-open/closed system where usually some resources enter (e.g., energy, labour); some resources exit (e.g., waste, services); and some resources, at least for some time, remain in the system (e.g., infrastructure, organisational routines and behaviours) (Potting et al., 2017). Assessing the contribution of their resources, practices and strategies to the CE is crucial for designing and prioritising circular solutions based on actual evidence (Corona et al., 2019). In line with the CE definition provided by Kirchherr et al. (2017) increasing circularity of organisations aims at contributing to overall sustainable development. The CE assessment literature produced and discussed a large number of CE indicators, for example, Saidani et al. (2018) reviewing 55 indicators and Parchomenko et al. (2019) reviewing 63 indicators. Literature reviews show that few indicators assess the actual impacts of CE practices and strategies to sustainable development (Kjaer et al., 2019; Matschewsky, 2019). CE indicators most commonly measure resource-efficiency as well as material stocks and flows (Parchomenko et al., 2019).

The public sector is considered to be a key actor in driving the CE concept (Khan et al., 2020). The political nature behind the public sector distinguishes it from other sectors (Lane, 2005). Public sector organisations are defined by the OECD (2019) as any organisation under government control that develops public goods or services (Lozano & von Haartman, 2018). Public sector organisations have a significant economic function by accounting for 47% of GDP in the EU expenditure (Eurostat, 2019b). They further have a role model function to other public sector organisation, NGOs, the private sector as well as citizens, for example, by infrastructure provision or tax policies (Domingues et al., 2017). In addition, they set the 'rule of the game' with important legislative landmarks (Parchomenko et al., 2019). Furthermore, the public sector as a provider of services generates significant material and energy input/output flows, both direct and indirect (Shrake et al., 2011). For example, the service sector is responsible for 13% of energy consumption in the EU28 (Eurostat, 2016a) and had a larger increase (+30%) than any other sector over the period 1990–2014 (Eurostat, 2016b).

In the public sector, CE assessment is already widely implemented at the macro level to measure the progress and impact of CE policies (Fidélis et al., 2021). China was one of the first countries to release a specific framework of indicators to track progress as pursued under the Circular Economy Promotion Law (People's Republic of China, 2008; Geng et al., 2012; People's Republic of China, 2016). This development was the start for more efforts for developing CE policies and appropriate indicators to assess CE policies, for example,

the EU Circular Economy Indicators (European Commission, 2020, 2015; Eurostat, 2019a) or the assessment defined in the action plan for circular economy in Portugal: 2017–2020 (Portuguese Ministry of Environment and Energy Transition, 2017).

However, in public sector organisations efforts towards CE are not often assessed at the micro level; moreover, according to recent works that reviewed CE assessment for public sector organisations, no tailored CE assessment for public sector organisations exists (Droege et al., 2020). Currently, the few cases of public and service sector organisations that are committed with CE assessment practices mainly use methods such as Life Cycle Assessment (LCA), Material Flow Analysis (MFA) and Input/Output Analysis. Among the methods in use, LCA is the one most commonly applied (Droege et al., 2020). LCA has been used to assess a variety of contexts such as public procurement (Cerutti et al., 2016), higher education (Lo-Iacono-Ferreira et al., 2017) or health care services (Malik et al., 2018). In principle, there is agreement that LCA and other assessment methods can be used to evaluate options for CE solutions. It is precisely because more circular solutions may not be environmentally preferable that it is appropriate to use assessment methods such as LCA, and not be satisfied with mere indicators of circularity (Brunklaus et al., 2009). This can lead to contradicting conclusions when applying LCA or mere CE indicators (Haupt & Zschokke, 2017). In addition, LCAs in use, including Organisational LCA (OLCA), a method still under development (Rimano et al., 2019), have several limitations when applied to an entire organisation system (Parchomenko et al., 2019). Despite the increasing availability of databases, LCAs share challenges, such as time intense execution, dependence on data quality and availability and the requirement for technical expertise, which makes implementation not flexible and particularly difficult in non-technical contexts, such as the public sector (Marx et al., 2020). Thus, some authors call for the development of new approaches for CE assessment (Moraga et al., 2019).

Due to the inherent differences between sectors, authors argue that organisations require different assessments, depending on their particular circumstances (Ki et al., 2020). Sector specific research on CE assessment is still in an exploratory stage, which suggests the selection of a participatory research design (Homrich et al., 2018). Therefore, this article aims to develop a framework for CE assessment in public sector organisations including stakeholders from the Portuguese public sector as an exploratory case study, to gain in-depth knowledge of CE assessment needs in public sector organisations (Lozano, 2020). The article answers two research questions: How can the CE performance of public sector organisations be assessed? What learnings can be derived for CE assessment literature and practitioners?

2 | DEVELOPING CE ASSESSMENT FRAMEWORKS FOR ORGANISATIONS

New methods for designing CE indicators are continuously being developed (Kristensen & Mosgaard, 2020a). Most of the new CE assessments use indicator frameworks (Roos-Lindgreen et al., 2020).

It is argued that compared to single indicators and indices, frameworks allow the inclusion of several indicator categories or topics and to associate relations among them (Lu et al., 2020). This enables frameworks to grasp the complexity of the multifaceted CE concept (Howard et al., 2019). To develop CE assessment frameworks for organisations the literature suggests four steps: (i) the system to be analysed is defined; (ii) within this system, detailed categories for CE assessment (CE elements) are identified; (iii) for each element, assessment targets are identified; (iv) then indicators to assess the progress from the baseline status towards each target can be selected (Marx et al., 2020; Pauliuk, 2018).

An explicit definition and description of the system to be analysed sets the scope of systematic and transparent indicator development and for tracing the progress towards CE (Marx et al., 2020). For public sector organisations there is no commonly accepted definition (Meyer & Leixnering, 2015). However, ministries and agencies at national level clearly belong to the core government (Denhardt & Denhardt, 2009). The literature describes the purpose of public sector organisations as to implement government policy and thus acting as the agent for the political principal in contrary to profit driven private organisations (Lane, 2005; Mintzberg, 1979). A key characteristic of most public sector organisations is their bureaucratic structure (Weber, 1921). This structure is reflected by non-competitive hierarchies and a clear distribution of responsibilities—'principle of jurisdiction' (Weber, 1921). Many public sector organisations follow similar bureaucratic principles, which facilitates the replicability of assessment frameworks (Lazzini et al., 2014).

Organisations have been conceptualised in the CE literature (Klein et al., 2020). Based on Lozano (2018), Klein et al. (2020) present public sector organisations as systems for which the areas of public procurement, resources, processes and operations as well as employee related activities are to be considered when implementing CE. The identified areas include many possibilities for CE implementation. Thus, several contributions identified more detailed assessment categories (CE elements). In public procurement, technical specifications, award criteria and contractual elements were considered for assessment (Kristensen & Mosgaard, 2020b). Emphasised key resources include furniture, paper, food, energy (Langfitt & Haselbach, 2017; Shueb & Mir, 2014). Legislation or service provision were highlighted as important processes and operational activities (Junnila, 2006, 2009; Kühnen & Hahn, 2018). Important social and employee related activities included stakeholder engagement and trainings for staff (Marimba et al., 2010; Nunes et al., 2018). The concrete CE elements can help organisations to understand where they should focus their CE assessment efforts.

To move away from the predominant linear paradigm, public sector organisations need to include CE principles within the organisation and especially in the identified CE elements (Rincón-Moreno et al., 2021). CE principles operationalise the concept by proposing strategies towards more CE (Geissdoerfer et al., 2017). The choice of the CE principle indicates the direction of the assessment target and indicator selection (Morseletto, 2020). The 10-R-hierarchy is widely spread (Kalmykova et al., 2018). It names 10 strategies from most linear 'R9—recover' to most circular 'R0—refuse' (Kirchherr et al., 2017; Potting et al., 2017). The 10-R-hierarchy directly addresses the contribution of the public sector organisation to the environmental quality but does not directly address the economic prosperity and social equity for current and future generations (Corona et al., 2019). The British Standard Institution (BSI) introduced CE principles also addressing economic prosperity and social equity. The BSI released the BS 8001:2017 as a standard to guide CE implementation in organisations (British Standard Institution, 2017; Pauliuk, 2018). The guideline includes six general principles to guide the choice of CE indicators. The principles are value optimisation, transparency, system thinking, innovation, stewardship and collaboration (British Standard Institution, 2017).

Ideally, CE indicators should provide an indication of how well the selected CE principle(s) are applied in the organisation (Sassanelli et al., 2019). The majority of existing CE indicators for organisations focus on the environmental and some the economic dimensions of sustainable development (Rossi et al., 2020). Social repercussions are rarely addressed (Tognato de Oliveira, 2021). A preliminary outline of a CE assessment framework for public sector organisations based on the literature is presented in Figure 1.

Few of the existing CE assessments included stakeholders in their development. The intended end-user has often been neglected in the development process and in many publications the possible end-user is not mentioned (Roos-Lindgreen et al., 2020). The literature on other micro-level assessments addressing sustainable development highlight stakeholder involvement as essential (Sierra-García et al., 2013). Coutinho et al. (2018) mention that involving stakeholders in developing assessments for public sector organisations can produce data in a voluntary and informal way. They further argue that it can accommodate changing circumstances; include a variety of knowledge, beliefs, behaviours, motivations, and values (Ramos et al., 2014). Falcone et al. (2019) add that stakeholder involvement helps to identify the main elements and indicators worth including in an assessment and to operationalise new processes, strategies, and outcomes according to these criteria. Therefore, this research involves a case study to include the perspective of stakeholders in CE assessment in public sector organisations.

3 | METHODOLOGICAL APPROACH

The limited knowledge and literature on CE assessment in public sector organisations justify the selection of the Portuguese CE Coordination Group (PCECG) as a single exploratory case study (Yin, 2009). The PCECG includes CE experts appointed by 11 Portuguese ministries coordinated by representatives from the ministries of the economy and the environment (Portuguese Ministry of Environment and Energy Transition, 2017). Flyvbjerg (2006) suggests that single case studies can produce valid research outcomes when the case in question is illustrative for the research purpose. The PCECG was selected based on a mix of purposeful and convenience sampling methods (Remler & Van Ryzin, 2011).
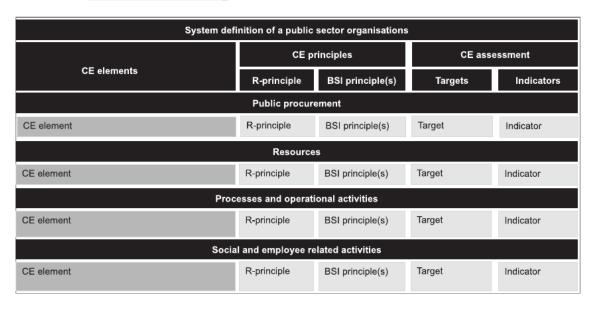
System definition of a public sector organisations				
CE elements	**CE principles**		**CE assessment**	
	R-principle	**BSI principle(s)**	**Targets**	**Indicators**
Public procurement				
CE element	R-principle	BSI principle(s)	Target	Indicator
Resources				
CE element	R-principle	BSI principle(s)	Target	Indicator
Processes and operational activities				
CE element	R-principle	BSI principle(s)	Target	Indicator
Social and employee related activities				
CE element	R-principle	BSI principle(s)	Target	Indicator

FIGURE 1 Preliminary outline of a CE assessment framework for public sector organisations based on the literature

3.1 | Selection of the exploratory case study

Three criteria were purposefully identified:

- The first criterion is CE expertise. Portugal has an all-encompassing CE strategy with a clear setting of priorities, the action plan for circular economy in Portugal: 2017–2020 (CE action plan). The PCECG consists of CE experts that drive the implementation of the CE action plan (European Economic and Social Committee, 2019; Portuguese Ministry of Environment and Energy Transition, 2017).
- The second criterion is assessment expertise. On the macro level the PCECG assesses the outputs and outcomes of the CE action plan with a clear set of assessment targets (Portuguese Ministry of Environment and Energy Transition, 2017). At the micro level there are also several assessment initiatives in Portuguese public sector organisations (Portuguese Government, 2020a)
- The third criterion is representation of different public sector organisations. The aim was to include a variety of organisations from the core government to get a broad picture of CE assessment needs.

In addition, the PCECG was chosen out of convenience as authors of this paper were familiar with CE assessment in the Portuguese context as they have been working together in other research projects (Droege et al., 2021). Potential impacts of the convenience sampling on generalisability of the data are acknowledged and mitigated with the purposeful selected criteria (Basurto & Speer, 2012; Berry & Browne, 2002).

3.2 | Methods

To develop a CE assessment framework for public sector organisations qualitative exploratory research was accomplished combining the methods of a literature review, a policy document review, interviews, as well as interactive workshops as a main method (Stebbins, 2001). According to Yin (2015) an exploratory study aims to explore a problem and collect information about the subject. We formulated the requirements of the assessment framework based on literature and tested it through empirical sections. Triangulating the different results allowed to gather knowledge and practical solutions at the same time, making the research outcomes more reliable and applicable (Yin, 2009).

The study began by conducting a literature review focused on CE assessment in public and private sector organisations. It was conducted via Scopus and the Web of Science. The two databases work well in combination and have a long-term worldwide coverage of peer-reviewed journals (Chappin & Ligtvoet, 2014). The search included scientific articles and book chapters. The used descriptors in the title, abstract or keywords were: (a) CE and the related schools of thought mentioned in Section 1; (b) 'assess*' and words used as synonym such as 'evaluat*', 'measure*', 'metric', 'index', 'indicator' or 'quantif*'; (c) 'organisation' and synonyms such as 'micro', 'institution' or 'company'. The search was followed by a screening process, performed by reading the title and abstract of every result. Studies focusing on the nano, meso or macro level (e.g., the assessment of products, supply chains or policies) were excluded. The selected studies explicitly addressed CE assessment within organisations. We examined bibliographies of selected contributions to identify further relevant literature. In the end, 184 relevant articles were selected. Out of the selected articles, 27 articles provided sector-specific input to the preliminary CE assessment framework for public sector organisations (Droege et al., 2020). The main findings were summarised in Table 1.

TABLE 1 Preliminary CE assessment elements for public sector organisations based on the literature CE

CE elements	References from the literature (direct and *indirect*)[a]
Key resources	
Water	Cruz et al., 2016; Elia et al., 2017; Junnila, 2009; Kubler et al., 2019; Lang and Kennedy, 2016; De Laurentiis et al., 2018; Martinez et al., 2018; Mendoza et al., 2019a; Nunes et al., 2018; Pajula et al., 2017; Pauliuk, 2018; Pelton and Smith, 2015; Shrake et al., 2013, 2011
Gasoline/diesel	Cerutti et al., 2016; Oliver-Solà et al., 2013; *Nunes et al., 2018*
Plastic	*Shrake et al., 2011, 2013*
Paper	Junnila, 2009; Shueb and Mir, 2014; *Shrake et al., 2013*
Food	Cerutti et al., 2016; De Laurentiis et al., 2018; Malik et al., 2018; Nunes et al., 2018; Shrake et al., 2013, 2011
Office supplies	Junnila, 2009, 2006; Mendoza et al., 2019a; Shrake et al., 2013, 2011; *Lang and Kennedy*, 2016; *Malik et al., 2018; Unger et al., 2016*
Electricity	Cruz et al., 2016; Elia et al., 2017; Finkbeiner et al., 2010; Fonseca et al., 2018; Junnila, 2006, 2009; Kubler et al., 2019; Lang and Kennedy, 2016; Marimba et al., 2010; Marique and Rossi, 2018; Mendoza et al., 2019a; Nunes et al., 2018; Oliver-Solà et al., 2013; Pauliuk, 2018; Pelton and Smith, 2015; Shrake et al., 2011, 2013
Thermal comfort	Junnila, 2009; Kubler et al., 2019; Marimba et al., 2010; Nunes et al., 2018; Pelton and Smith, 2015; Shrake et al., 2011; *Mendoza et al., 2019a*
Furniture	Junnila, 2006, 2009; Mendoza et al., 2019a; *Shrake et al., 2011, 2013*
Computers and laptops	Junnila, 2006, 2009; Kubler et al., 2019; Shrake et al., 2011; *Mendoza et al., 2019a; Shrake et al., 2013*
Phones	Junnila, 2006, 2009; Shrake et al., 2011; *Mendoza et al., 2019a; Shrake et al., 2013*
Printers	Shrake et al., 2011; *Junnila*, 2006, 2009; *Mendoza et al., 2019a; Shrake et al., 2013*
Means of transport	Junnila, 2009; Nunes et al., 2018; Shrake et al., 2013, 2011; Cerutti et al., 2016; *Junnila*, 2006, 2009; *Lang and Kennedy*, 2016; *De Laurentiis et al., 2018; Malik et al., 2018; Marimba et al., 2010; Mendoza et al., 2019a*
Land/space utilisation	Elia et al., 2017; Junnila, 2009; Lang and Kennedy, 2016; Marique and Rossi, 2018; Martinez et al., 2018; Mendoza et al., 2019a; Pauliuk, 2018; *Junnila*, 2006; *Shrake et al., 2011*
Buildings	Junnila, 2009, 2006; Marique and Rossi, 2018; Mendoza et al., 2019a; Nunes et al., 2018; Shrake et al., 2011, 2013; *Lang and Kennedy*, 2016; *Martinez et al., 2018; Oliver-Solà et al., 2013*
Key operations and processes	
Regulation/legislation	*Marimba et al., 2010; Mendoza et al., 2019a*
Service provision	Nunes et al., 2018; Junnila, 2006, 2009; Malik et al., 2018; Mendoza et al., 2019a; Shrake et al., 2011, 2013
CE projects	Mendoza et al., 2019a; Nunes et al., 2018; Marimba et al., 2010; *Kubler et al., 2019*
Education/awareness	Mendoza et al., 2019a; *Nunes et al., 2018; Marimba et al., 2010; Shrake et al., 2013*
Internal CE strategy	Fonseca et al., 2018; *Nunes et al., 2018; Marimba et al., 2010*
Biodiversity actions	Nunes et al., 2018
Commuting/transport	Junnila, 2009, 2006; Marimba et al., 2010; Marique and Rossi, 2018; Nunes et al., 2018; Shrake et al., 2013, 2011
IT-Performance	Kubler et al., 2019; Shueb and Mir, 2014; *Malik et al., 2018*
Administration	Malik et al., 2018; Mendoza et al., 2019a; Shrake et al., 2013, 2011; Unger et al., 2016; *Junnila*, 2006, 2009; *Marimba et al., 2010*
Auditing	Marimba et al., 2010; Shrake et al., 2013, 2011
Key social and employee related activities	
Social objectives	Marimba et al., 2010; Nunes et al., 2018; *Pauliuk*, 2018
Stakeholder engagement	Nunes et al., 2018; *Marimba et al., 2010; Pauliuk*, 2018
Equal opportunities	Marimba et al., 2010; *Nunes et al., 2018; Pauliuk*, 2018
Trainings for staff	Marimba et al., 2010; *Nunes et al., 2018*
Work wellbeing	Nunes et al., 2018; *Marimba et al., 2010*
Top management involvement	Marimba et al., 2010; *Nunes et al., 2018*
Employee participation	Marimba et al., 2010; Nunes et al., 2018

[a]Direct refers to the explicit mentioning of the element in the referenced article; *indirect* (references in italics) refers to the mentioning of a very similar element or using different terminology for the same object/concept, for example, the element gasoline/diesel was called 'fuel' in Nunes et al. (2018).

	Aim	Method	Guidance from the research team
Work-shop 1	Problem introduction	Presentation	Based on literature
	Identification of CE assessment goals	Individual brainstorming using mentimeter.com	Examples from literature
	Definition of elements for CE assessment	• 3 parallel focus group discussions (rotating) • Plenary discussion of main points	CE elements from 27 analysed articles in literature review
	Operationalisation of CE asssessment elements	• 3 parallel focus group discussions (rotating) • Plenary discussion of main points	CE principles (R-principles, BSI-principles)
	Feedback	Individual brainstorming using mentimeter.com	
Work-shop 2	Recapture and validate results workshop 1	• Partner discussion • Plenary discussion of main points	Framework draft based on literature review and workshop 1
	Define first targets for CE assessment for each element	• 3 parallel focus group discussions (rotating) • Plenary discussion of main points	Assessment target definition and examples from literature
	Propose indicators to assess each element	• 3 parallel focus group discussions (rotating) • Plenary discussion of main points	Indicator definition and examples from literature
	Prioritise CE assessment categories	„Dotmocracy" exercise	Priorisation matrix
	Feedback	Individual brainstorming using mentimeter.com	

FIGURE 2 Description of aims, methods and guidance in the two participatory workshops

During a field-based exploration, part of the research team spent two weeks working in the Portuguese public administration (Stebbins, 2001). The exploration aimed at getting an understanding of the status of CE assessment in Portuguese public sector organisations and complementing the information from the literature review. During that period, relevant policy documents for CE assessment such as the action plan for the circular economy in Portugal: 2017–2020 (Portuguese Ministry of Environment and Energy Transition, 2017) or the resolution to reduce paper and plastics consumption of Portuguese public sector organisations (Resolution (141/2018), 2018) were identified and collected. Key findings of the policy documents were synthesised and documented. Furthermore, 21 members of the PCECG were interviewed in semi-structured interviews. The interviews were conducted in person and lasted between 45 and 90 min. All results were transcribed. Some of the interview findings were used for other research outcomes (Droege et al., 2021).

In line with similar studies by Coutinho et al. (2018) or Falcone et al. (2019), the main method to gather primary data were two participatory workshops. They were held in December 2019 and January 2020 with a 3-week break in between to allow time for reflection, analysis and preparation by the research team, since the outcomes from workshop 1 would influence the scope of workshop 2. Each workshop lasted 4 h to avoid information overload and minimise interruption to the stakeholders' activities (Heyes et al., 2018; Mendoza et al., 2019b). A total of 11 members of the PCECG were present during the first workshop, and 9 members in the second one. For consistency, most of the workshop participants were those previously interviewed. The number of participants is similar to existing studies involving workshops and they represented ministries involved in the PCECG (Coutinho et al., 2018; Döring et al., 2015; Falcone et al., 2019). The two interactive workshops were divided in two parts:

• Workshop 1—answered the question: 'which elements need to be considered for CE assessment in public sector organisations?' by evaluating a preliminary CE assessment framework (Figure 1, Table 1) and further developing it.

• Workshop 2—answered the question: 'how can the CE performance of a public sector organisation be assessed?' by co-developing CE assessment indicators.

A variety of exercises using different methods, such as focus groups, were executed in both workshops (see Figure 2). Focus groups encourage participants' discussion on the CE assessment framework as well as the identification of its weaknesses and strengths. In order to facilitate those discussions, the research team participated explaining the exercises in more detail and answering questions.

Prior to the workshops a brief description and agenda of the workshop, summarising its purpose and practical activities had been sent to the participants. During the workshop all results were discussed among the participants and the final answers were written down. At the end of each workshop, participants were asked to review the workshop results and provide feedback of what could be improved and what went well. This feedback gave space to the participants to express any concerns.

The empirical data was analysed in a qualitative content analysis according to Bryman (2012). The qualitative data from the workshops was analysed through a structured coding procedure (Denzin & Lincoln, 2005). The coding framework was developed based on findings from the literature (Figure 1, Table 1) and the status information obtained during the field-based exploration, including the interviews and policy documents. The coding process focused on a CE assessment aim, a CE assessment system definition, CE elements, CE assessment targets and CE indicators. After the coding, the materials were analysed by the researchers (e.g., identifying redundancies and repetitions), resulting in a consolidated CE assessment framework. The final result has been summarised in section 4 and 5 of this article.

There are limitations associated with exploratory research and case studies, including issues regarding validity, transparency and generalisability (Bryman, 2012). For example, due to the strict selection criteria, only a small number of internal stakeholders has been included in this analysis. However, research suggests it is possible to reach thematic saturation after involving 12–16 people (Creswell,

2014). This has been reflected during this research. The participants did not provide new answers when they were asked to name further stakeholders matching the selection criteria. Furthermore, in the reflection phases at the end of both workshops no new data has been produced anymore, which indicates thematic saturation (Fusch & Ness, 2015).

4 | RESULTS

The empirical data confirms the system definition described in Section 2 and shown in Figure 1. All workshop participants agreed that public procurement, resources, processes and operations as well as employee related activities set the adequate frame for identifying more specific CE elements. However, public procurement was excluded from the framework. In public sector organisations, inputs (e.g., goods and services) are mainly acquired through public procurement involving complex tender processes (Kristensen & Mosgaard, 2020b). The interviews and workshops highlighted that Portugal, similar to many other European countries, bundled public procurement responsibility and execution in one organisation, the Government Shared Service Entity in Portugal (eSPap). In Portugal, organisations such as ministries and agencies request most inputs from the eSPap, who then execute the purchase (eSPap, 2020). Therefore, public procurement is not explicitly included in the system definition, as most public sector organisations can exert higher influence on their outputs than their inputs. The literature confirms this decision, because circular or green public procurement is often analysed separately not at the same time as the overall organisational CE performance. Authors such as Cerutti et al. (2016), Cruz et al. (2016) or De Laurentiis et al. (2018) analyse assessments of public procurement decisions with methods such as ISO standards, LCA or carbon footprint indicators of products and/or processes.

By evaluating and developing the CE elements, all workshop participants added sector specifics to the framework. At the same time, the framework aims to reflect those CE assessment aspects that are transversal and common to different public sector organisations. For example, the list of 31 CE elements derived from the literature (Table 1) was discussed and largely extended to 75 CE elements during the first workshop. Especially in the areas of operations and processes as well as social and employee related activities, public sector specific elements were added, such as: new CE related regulation/legislation, monitoring and auditing of CE related regulation and activities or funding and support of CE related projects (Table 2). Nevertheless, the research team needed to consolidate the detailed inputs afterwards to facilitate usage and prevent duplications.

A major reason for the consolidation of elements is the addition of CE elements that are only relevant to one particular organisation (similar to the public procurement example mentioned above). For example, in the first workshop a representative of the Ministry of Defence proposed 'emergency equipment' as a CE element. Due to their bureaucratic structure, Portuguese public sector organisations have varying but clearly defined responsibilities, tasks and interests. For instance, the Ministry of Defence mainly protects the country

sovereignty or defends its interests abroad and the Ministry of Environment works on topics such as preventing climate change or ensuring biodiversity (Portuguese Government, 2020b). These organisation-specific CE elements were excluded from the framework. However, institutions are encouraged to add their specific elements during the implementation of the framework. Thus, the line 'other' was introduced (Table 2). Another reason for consolidation is that the participants provided too much detail to some of the CE elements. The existing CE element from the literature 'electricity' was concretised by proposing the CE element 'illumination'. Balancing comprehensiveness and parsimony, the demand for more transparency was addressed by adding an 'example' column to the framework (Table 2). The third reason for the large increase is that some participants accidentally added CE principles, for example, 'refuse' as CE elements. These inputs have been collected and saved for discussions in workshop 2.

Within the defined system and identified CE elements, the empirical data shows that public sector organisations aim to address all dimensions of sustainable development: environmental, economic, social and institutional as suggested by Brown (1991). This is in line with the all-encompassing Portuguese CE action plan (Portuguese Ministry of Environment and Energy Transition, 2017). To capture different facets of the CE, a variety of CE principles were allocated to the CE elements. For example, for the CE element 'food', 'rethink and reduce' in combination with 'value optimisation and innovation' were proposed having the target of a reduction of food waste in mind and also accounting for non-material ideas such as introduction of more sustainable food choices. Moreover, the principles 'system thinking' and 'stewardship' were commonly allocated together. The workshop participants argued that, for example, CE strategy development needs to be understood and assessed in interaction with the wider systems such as the private sector or citizens (system thinking) and direct and indirect impacts need to be monitored (stewardship; see Table 2).

During the second workshop the participants discussed CE assessment targets and indicators for each CE element. The discussions reflected a clear preference for simple assessment targets and indicators from all participants, valuing user-friendliness. Participants highlighted two main preferences for the choice of targets and indicators (see Table 2). First, participants preferred assessing each CE element with only few (mainly one) indicators. Second, within one indicator they chose to assess one target at a time. The combination of too many indicators per CE elements and multiple targets in one indicator were perceived as too complex and requiring too much technical expertise for a service-based public sector organisation.

Moreover, in line with the existing literature, the discussion emphasised a need for new CE indicators in public sector organisations (Staniškienė & Stankevičiūtė, 2019). The empirical data showed an emphasis on the social dimension of CE. During the first workshop the participants suggested assessment aims, such as: increasing social sustainability or improving the level of welfare. Even though many authors highlight the necessity of including social indicators, indicators for social and employee related activity of public sector organisations are practically absent in CE

TABLE 2 Final version of the co-developed CE assessment framework for public sector organisations

CE element	Example	R-principle	BSI principle	Target	Indicator	Priority (importance/feasibility)[a]
Key resources						
Water	Drinking water, water used for toilets	Reduce	Value optimisation	Reduce fresh water usage	m^3 of fresh water used	Moderate
Fuel	Gasoline used by the organisation's cars	Reduce	Value optimisation	Reduce gasoline/diesel usage	Litres of gasoline/diesel used	Low
Electricity	Lighting, thermal comfort	Reduce	Value optimisation	Reduce electricity usage based on fossil fuels	J/m^2 of electricity from fossil fuel used	Moderate
Plastic	Single use plastic bottles, foil	Refuse	Value optimisation	Refuse usage	m^3 of plastic waste	Low
Paper	Printed documents	Reduce	Value optimisation	Reduce usage (only print out documents where printed version is necessary)	# of documents printed	Low
Food	Food consumed in the canteen/on the organisation's premises	Rethink/reduce	Value optimisation	Reduce food waste/reduce animal products	m^3 of food waste; # of animal product free days	Low
Office supply	Perforators, sharpeners	Rethink/reduce/reuse	Value optimisation	Increase time in use	# of ordered office supplies	Low
Other consumables	Fabrics, cleaning products, laboratory equipment					
Furniture	Tables, chairs	Repurpose	Innovation/value optimisation	Increase time in use	Time in use per product	Moderate
Electronic devices	Phones, laptops/computers, printers	Recycle	Innovation/value optimisation	Increase recycling of old products	% of electronic devices recycled	Low
Means of transport	Cars, bikes, scooters	Rethink	Collaboration/innovation/value optimisation	Increase electric/hydrogen/human powered means of transport	% of usage of electric/hydrogen/human powered means of transport	Low
Land/space	Building grounds, forests	Rethink	Innovation/value optimisation	Improve land/space management in forest areas, sharing strategy for some parts of land, reserves	Net CO_2 emission per ha owned by the organisation	Moderate
Buildings	Office buildings, facilities of the ministries/agencies	Refurbish	Innovation/value optimisation	Increase sustainable buildings	# of buildings in line with eco design criteria	Low
Other durables	Organisation specific durables, for example, emergency equipment, laboratory equipment					Low
Key operations and processes						
Operations						
New regulation/legislation	New CE directives, laws, recommendations		System thinking/stewardship/transparency	Increase CE content in regulation/legislation	% of regulation/legislation with CE content	Low
Monitoring/auditing	Ensuring compliance with existing CE legislation; Monitoring of physical environments in line with CE principles		Stewardship/system thinking/value optimisation/transparency	Decrease violations of CE regulation/legislation	# of registered incidents related to CE regulation/legislation	Moderate

TABLE 2 (Continued)

CE element	Example	R-principle	BSI principle	Target	Indicator	Priority (importance/ feasibility)[a]
Strategy	Internal and external CE strategies		System thinking/ stewardship	Increase CE content (in relevant) strategies	% of relevant strategies with CE content	Moderate
Projects	Initiate/support/ promote CE projects (e.g., Refood in Portugal), promote CE education/awareness; biodiversity actions		Innovation	Increase funding for CE projects/ activities	EUR spent for CE projects	High
Service provision	CE thinking in: licencing and permits, remote services		Stewardship	Increase CE content/ action in service provision	% of relevant services including CE content/actions	Moderate
Other operations	Organisation specific operations					
Processes						
Commuting /transport	Commute to work, business trips		System thinking/ collaboration/value optimisation	Decrease CO_2 emissions related to travel	Net CO_2 emission per trip	Low
Administration	Internal procedures, for example, timesheets, travel expenses		Value optimisation/ transparency	Increase dematerialisation	% of end-to-end digitised processes	Low
IT-Performance	Server capacity, online platforms		Innovation	Facilitate online working	# of IT issues reported	Low
Other processes	Organisation specific processes					
Key social and employee related activities						
Social activities						
Stakeholder engagement	Stakeholder consultations on CE topics		Collaboration	Increase interaction (meetings, events, with stakeholders)	# of CE related meetings with stakeholders	High
Local/regional activities	Involving local community		Collaboration	Increase local initiatives	# of local initiatives	Moderate
Other social activities	Organisation specific social activities					
Employee related activities						
Trainings for staff	Trainings on responsible resource use		Innovation/value optimisation	Increase hours of (CE) training per employee	# of minutes of (CE) training per employee per year	Low
Work wellbeing	Compensation, incentives for families		System thinking	Increase employee satisfaction	Employee satisfaction on a scale	Low
Equal opportunities	Promoting gender, ethnicity, disability, age, equality		Transparency	Provide equal working conditions	% of women, non-Portuguese, people with disabilities, different ages	Low
Top-management involvement	Top-level CE events, CE decisions		Transparency/ collaboration	Increase CE action of top-management	# of top-management CE actions	Moderate
Employee participation	Initiation of and participation in CE activities		Collaboration	Increase CE actions by employees	# of employee CE actions	Low
Innovation development	Facilitating acceleration of CE ideas		Innovation	Increase occasions (e.g., workshops,	# of CE innovation meetings/work-	Low

(Continues)

TABLE 2 (Continued)

CE element	Example	R-principle	BSI principle	Target	Indicator	Priority (importance/ feasibility)[a]
				brainstormings) for CE innovation	shops/ brainstormings	
Recruitment incentives	New positions related to CE		Transparency	Increase CE requirements in job adverts	% of job adverts with CE content	Low
Other employee related activities	Organisation specific employee related activities					

[a]Low 0–1 votes; Moderate 2 votes; High +2 votes.

assessment research (Banaitė & Tamošiūnienė, 2016). To include this dimension, participants were invited to think 'out of the box'. The French government, for example, introduced CE indicators such as number of industrial and territorial ecology projects, household spending on product repair and maintenance, employment generated in CE activities (Corona et al., 2019). In a similar manner, the participants proposed new indicators, for example '# of CE related meetings with stakeholders' or '# of minutes of (CE) training per employee per year' (Table 2).

Lastly, the participants argued that some of the selected CE indicators are more important drivers for CE implementation and easier to apply considering data availability and effort than others. All participants named priorities. The allocation of priorities is scattered across the CE elements and thus supports the systemic view of CE assessment (Table 2). In line with authors such as Mendoza et al. (2019b), the workshop participants prioritised the CE indicator '# of CE related meetings with stakeholders'. The discussion reflected that solving a cross-cutting issue such as CE requires engagement of all ministries. Moreover, the participants prioritised the indicator 'Euros spent for CE projects' in public sector organisations as a key driver for the CE transition of the public sector. All participants highlighted the impact positive communication of assessment results can have on other public sector organisations, the private sector and citizens. The resulting CE assessment framework is presented in Table 2.

5 | DISCUSSION AND IMPLICATIONS FOR THE PUBLIC AND PRIVATE SECTOR

The previous section presents a co-developed CE assessment framework for public sector organisations based on the case study of the Portuguese public sector. The analysis highlights that a public sector specific CE assessment framework differentiates from existing CE assessments on the micro level mainly in three ways: (1) Existing CE assessment efforts clearly focus on the environmental and economic dimensions of sustainable development (Rossi et al., 2020). Instead, the developed CE assessment framework follows an integrated CE perspective, covering the environmental, economic, social and

institutional dimension of sustainable development. Following a holistic CE assessment thinking, the social dimension of CE is focused on, which constitutes a distinctive angle, when compared with the existing assessment initiatives (Rincón-Moreno et al., 2021). (2) The majority of existing CE assessments at the micro level are not developed to only assist certain sectors (Roos-Lindgreen et al., 2020). However, the developed CE assessment framework includes sector-specific CE elements to respond the particular sectoral views, needs and aspirations. (3) Existing CE assessments are often fuzzy and multi-faceted, which results in complexity for the user (Saidani et al., 2018). The selected CE indicators mainly address one target at a time and, thus, try to reduce complexity of the CE assessment for the user. Even though this research is only based on one case study in the public sector, there are broader theoretical and practical implications for the development and use of CE assessments in the private and public sector to be explored by future research.

First, in line with Saidani et al. (2018) the empirical findings highlight that it is important to include sector specifics in the development of micro-level CE assessment framework. In the current literature on CE assessment most approaches developed are generic and supposed to be applicable to any sector (Saidani et al., 2018). However, the empirical data showed that the public sector encounters difficulties when considering the generic frameworks, as they include indicators that are not relevant for CE assessment of a service-based organisation and/or require very complex assessment methods that are not feasible to be executed by most public sector professionals. Public sector organisations, therefore, often involve external consultants to support the assessments (Kristensen & Mosgaard, 2020b). Authors addressing sector specific CE assessment in private sector organisations confirm the need for tailored assessments (Aravossis et al., 2019). Particularly, small private sector organisations, do not have the staff and financial resources needed to implement generic and complex methods either internally or though consultants (Prieto-Sandoval et al., 2019). The development of sector specific assessment approaches would not only benefit the CE assessment literature and practitioners, contributing to explore and overcome some of present challenges, namely, resistant organisational cultures, complex institutional structures or technical complexities (Droege et al., 2021), but

also contribute to the continuous evolution of the CE concept in different organisational and sectoral contexts (Saidani et al., 2018).

Second, the empirical findings highlight the importance of involving target organisations in the development of CE assessment framework. In the introduction we derived from the literature (Sierra-García et al., 2013) that stakeholder engagement could enrich the development of CE assessment approaches. The empirical data strongly confirmed this hypothesis. During the workshop most participants argued that the absence of stakeholder involvement leads to a failure of CE assessment implementation. We observed that developing a CE assessment framework involved many decisions including what to assess and how to assess it. It was, thus, important to understand the needs and requirements of the specific organisations. In line with the literature, we argue that it was also essential to include employees in the process to facilitate later implementation and get a buy-in from the targeted organisations (Falcone et al., 2019). Based on the findings, we argue that new contributions to the CE assessment literature in public and private organisations should increasingly include stakeholder perspectives, following an open and dynamic participative approach, where relevant actors can have a key role through a joint commitment among stakeholders, for active assessment design and development with new information and knowledge (Ramos et al., 2014). We argue that the co-development process applied under this research might be transferable to co-develop sector specific CE assessments in other areas, for example, the service sector.

Third, balancing complexity and user-friendliness bears challenges. The selected indicators often cannot capture the complexity of CE, and thus present an overly simplified measure of circularity (Reike et al., 2018). For example, targeting the reduction of fossil fuel-based electricity usage (see Table 2) disregards targets such as the overall reduction of electricity consumption or the increased share of renewables and, thus, does not necessarily reflect the multi-dimensionality of the CE concept well (Moraga et al., 2019). Therefore, in the literature, CE indicators often try to target multiple CE principles and/or sustainable development dimensions at once (Kristensen & Mosgaard, 2020a). Bocken et al. (2016) further argue that resource-efficiency and the reduction of resources in itself (even though high in the R-hierarchy) are not circular principles, as they do not deal with the actual flowing of resources, but only the amount used. They should be combined with other principles for closing resource loops or slowing resource loops through repair, reuse, remanufacturing, among others, to comprehensively support a CE. Due to these challenges, particularly in the early stages of CE assessment it is important to continuously test, adjust and redefine the assessment framework and aim. Pauliuk (2018) highlighted the main reason for the refusal of complex CE assessments lies in the early stage of CE strategy development and the resulting lack of relevant experience from the CE reality. With increasing experience, the selected indicators can and should be revised in line with the organisations' progress towards CE and the increase of data and expertise in the topic.

Lastly, literature shows that CE assessment might support undesirable burden shifting and rebound effects (Harris et al., 2021).

During the framework development it was assumed that improving CE performance leads to increased sustainable development overall (Cecchin et al., 2020). However, the developed framework, like most CE assessments, does not explicitly assess the impacts of CE activity on sustainable development (Harris et al., 2021). In practice, this could lead to a scenario where for example an organisation optimises their resource use for the target of plastic reduction but replaces the material by an option that is less sustainable according to other dimensions or indicators (Figge & Thorpe, 2019). Therefore, it can be of utmost importance to include an assessment of the impact of the CE activity on sustainable development, as CE practices do not automatically lead to an overall increase of sustainable development (Blum et al., 2020).

6 | CONCLUSIONS

The inclusion of CE assessment in public sector organisations can drive the CE transition by evaluating and communicating an organisation's progress. To facilitate implementation, this article co-develops a CE assessment framework for public sector organisations. It shows how to assess CE performance of public sector organisation by including the following components: (i) a system definition with the three dimensions: key resources, key processes and operations as well as key employee and social related activities; (ii) a definition of 35 relevant CE elements; (iii) the allocation of CE principles for each CE element; (iv) the development of CE indicators to assess the distance to target for each CE element in public sector organisations.

Novelties of this framework are that it explicitly focuses on the public sector and involved target organisations in the development process. As a result, an original CE assessment scope, unique assessment elements as well as new CE indicators were developed. Besides, this research highlights implications for CE assessments organisations across sectors. Methodologically, it shows how to co-develop a CE assessment framework with the active involvement of internal stakeholders, in a process where their facts and figures, views, perceptions, desires and needs were a central support for the framework design and development. Including employee perspectives emphasises the importance of sector specifics in CE assessments of organisations and for acknowledging user-friendliness for public and private organisations. Furthermore, the critical analysis of the literature and the empirical results highlight the need to continuously improve and adapt CE assessment frameworks and the necessity to assess the actual impact of CE activity on sustainable development.

However, the exploratory design of this case study bears limitations. The selection of one case study does not allow to generalise results. In that sense, findings supported by the literature and the methodological approach are generalisable, that is, they can be applied in a different context, whereas our empirical results are specific to the Portuguese context, that is, not fully transferable. Furthermore, the framework was co-developed with members from Portuguese public sector organisations but it has not been empirically tested yet. Feasibility and the overall impact of the CE assessment to the sustainable development need to be empirically tested with internal and external

stakeholders to ensure assessment quality. These limitations point to paths for future research. Today, we are still far away from widely accepted approaches to CE assessment. Proposing a framework at this stage cannot be a unique solution but only one step closer to a better understanding of CE assessment at organisational level. First, the role of specific sectors, for example, service sector, public sector, manufacturing sector, in the CE transition need to be better understood. In addition, empirical tests and validation of existing CE assessments are vital to investigate if the adoption of CE principles leads to increased sustainable development and under what conditions this is possible. The integration of co-development and participatory elements involving internal and external stakeholders in the CE assessment literature can close the growing gap between complex inputs from the literature and practical implementation.

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