CRANFIELD UNIVERSITY

MARINE PONCET

UNDERSTANDING THE SOCIETAL LEGITIMACY OF THE CIRCULAR ECONOMY FOR THE WATER SECTOR

SCHOOL OF WATER, ENERGY AND ENVIRONMENT
Water Science Institute

PhD in Social Science
Academic Year: 2019 – 2023

Supervisors: Dr Heather Smith & Professor Paul Jeffrey
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ABSTRACT

The water sector employs Circular Economy (CE) principles through many applications, such as the reuse and recovery of water, nutrients, and energy. Although such applications are helpful to tackle increasing global water and food demands, and help reach net zero emissions targets, there are many challenges to achieving wide uptake. Societal-based and cultural-based challenges are some of the least studied and most pressing barriers to address. Understanding the perceptions of various actors towards CE applications has narrowly focused on the acceptance perspective. However, perceptions may be better understood by connecting CE applications with their institutional landscapes using the theoretical framework of legitimacy. To date, the application of Legitimacy Theory to CE applications has been limited.

This thesis aims to extend the prevailing theoretical thinking on legitimacy to a wide range of water-centric CE applications, including water reuse, nutrients and energy recovery in Europe, and understand the legitimacy of CE applications through perceptions. This study was underpinned by a tailored framework including four legitimacy categories: moral, cognitive, pragmatic, and regulatory. A qualitative and case study research design was employed, involving interviews with case study stakeholders (n = 44) and the public (n = 12). A thematic analysis using mainly a deductive logic was employed to associate interviewees' perceptions with legitimacy categories. This thesis provided evidence of stakeholders' perceptions towards contemporary case studies embedding CE applications in Sweden, the Netherlands, and the UK, as well as public perceptions of hypothetical CE applications in the UK.

For stakeholders and the public, findings described perceptions associated with the four legitimacy categories and thus showed the meaning of legitimacy associated with CE applications. For each case study and legitimacy category, interviewees portrayed a common basis of legitimacy and contextual specificities that included differences in the number of times a specific legitimacy sub-category was referred to in the interviews. Overall, perceptions placed high

importance on legitimacy associated with social and environmental norms, and self-interested benefits, comprehensibility, and taken-for-granted routines whilst depicting low legitimacy associated with outreach and involvement practices as well as with regulations. Finally, the main linkages between legitimacy categories were reported.

This research makes two contributions. Firstly, it contributes to the CE literature by providing a complementary view to an acceptance perspective and showing a non-binary, in-depth, and nuanced view of institutional, social, and cultural factors. Secondly, a theoretical contribution was made that extends the interpretation of legitimacy in a CE context, and challenges existing knowledge on legitimacy by providing a non-linear, context-dependent, and complex view on legitimation processes. Finally, practical recommendations were formulated for outreach managers, regulators, the government, and prospective companies. These are based on using the legitimacy framework as a diagnostic tool to build specific legitimacy categories.

Keywords:

Legitimacy; Circular Economy; Public and Stakeholder Engagement; Water

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LIST OF ABBREVIATIONS

CE	Circular Economy
CEO	Chief Executive Officer
CTO	Chief Technology Officer
NGO	Non-Governmental Organisation
R&D	Research and Development

1 INTRODUCTION

1.1 The Circular Economy Concept

A Circular Economy (CE) is based on the principles of designing out pollution and waste, keeping materials and products in use, and regenerating nature (Ellen MacArthur Foundation, n.d.). Whilst the CE has received many criticisms based on, for instance, thermodynamics limitations stating that recycling will always require input due to entropy (Korhonen et al., 2018), it remains a valuable concept to tackle current and future challenges. The principles of the CE can be directed towards a range of societal and environmental challenges, including climate change, biodiversity loss, waste, and pollution (Ellen MacArthur Foundation, n.d.; Kumar et al., 2019). In terms of its development, the CE emerged from similar concepts that include industrial ecology, cradle-to-cradle, cleaner production, and industrial symbioses (de Jesus et al., 2016). It has received interest across various research fields, including environmental science, process engineering, and social science (Lieder & Rashid, 2016). Whilst the economic and environmental dimensions of the CE have been extensively studied in the literature, greater efforts have been called upon to explore the societal and institutional changes and particularly the perceptions that support or hinder the concept (Merli et al., 2018; Villarín & Merel, 2020).

1.2 A CE in the water sector

Many utility sectors, such as the water and energy sectors, have embraced the CE concept. Water as part of the CE has been conceptualised with concepts such as Water-Smart CE (Salminen et al., 2021) and CE of water (CEW) (Morseletto et al., 2022). Moreover, studies establishing the link between water and the CE have recently flourished (Gherghel et al., 2019; Smol et al., 2020; Tahir et al., 2019; Voulvoulis, 2018). There are many water-centric technologies and practices located in both municipal and industrial settings that support the CE concept. These technologies allow for the reuse of water, and recovery of nutrients and energy from wastewater, which particularly aim to keep materials and products in use.

Examples of the potential benefits that an intensified focus on CE principles could bring include, tackling the increasing global demand for water (Burek et al., 2016), through reusing water from wastewater. Moreover, recovering and recycling nutrients from wastewater, such as phosphorus, which most countries would otherwise import, can contribute to ensuring agriculture and food security (Brownlie et al., 2022) in light of a growing global food demand (Alexandratos & Bruinsma, 2012). Finally, a CE has great potential to help reach net zero emissions targets by 2050, as called for in the Paris Agreement, with the recovery and use of biogas generated from wastewater sludge as an alternative to fossil fuels (Tyagi & Lo, 2013).

1.3 CE challenges in the water sector

Whilst some regions, such as California, have successfully established water reuse as commonplace (Binz et al., 2016), in other areas, for instance, the town of Toowoomba in Australia, public opposition and political factors detracted from a proposed water reuse scheme, which was abandoned after residents voted against the scheme in a referendum (Hurlimann & Dolnicar, 2010). Two years later, the Western Corridor Recycled Water Project was paused, and it was decided that it would only be used to supply potable water in an emergency when reservoir levels dropped to 40% of total capacity (Hurlimann & Dolnicar, 2010; Meehan et al., 2013; Ross et al., 2014). Another instance where CE applications in the water sector were challenged was a ban on sludge used as a fertiliser in Germany due to growing concerns over harmful substances and pathogens (Federal Department of the Environment, Transport, 2003).

Challenges to a CE in the water sector have been detailed in studies that adopted a range of approaches, including the PESTEL analysis (Lee & Jepson, 2020). These studies map the drivers and challenges to wider adoption of CE applications in the water sector (e.g., Kakwani and Kalbar (2020), Mainardis et al., (2022), Salminen et al., (2021), Lee and Jepson (2020)). These challenges can be economic and relate for instance, to the additional costs incurred during the exchange of water resources between stakeholders and the construction of

pipelines and recycling plant facilities (Bischel et al., 2012). There can be technological challenges, including the complexity of energy recovery systems for biogas production (Gherghel et al., 2019), or environmental challenges with a risk of contaminants release (Carr & Potter, 2013). These can also relate to the market with, for instance, a low price competitivity of recovered nutrients (Salminen et al., 2021).

An approach that considers social, environmental, economic, technological, and political aspects is essential to achieve successful CE implementation (Gherghel et al., 2019; Kakwani & Kalbar, 2020; Sgroi et al., 2018; Voulvoulis, 2018). Nonetheless, societal-based factors are one of the most pressing challenges to address (Bischel et al., 2012; Kakwani & Kalbar, 2020; Kirchherr et al., 2018). Examples of societal-based factors are reported in Table 1. Yet, research on factors such as social norms, institutional and cultural aspects are rather limited in the literature on the CE since they may be less tangible to capture when compared to practical aspects like economic and technological ones. Social challenges and particularly stakeholders' perceptions in the context of CE applications in the water sector have been under-explored and require further investigation (Gherghel et al., 2019; Kakwani & Kalbar, 2020; Mainardis et al., 2022; Villarín & Merel, 2020).

Table 1 – Societal-based factors challenging the CE according to many stakeholders

Stakeholder	Challenge	Reference
Public	Lack of trust in overseeing organisations	Ormerod and Scott (2012)
	Yuck factor	Smith et al. (2018)
	Health risk perceptions	Russel and Lux (2009); Rozin et al. (2015); Mbavarira and Grimm (2021)

Stakeholder	Challenge	Reference
Farmers	Uncertainty about consumers' willingness to buy products irrigated with reused water	Massoud, Terkawi and Nakkash (2019)
	Risk perceptions regarding pathogens	Martinez and Pellerin (2016)
Water professionals	Reluctance to adopt innovative approaches, challenges to develop inter-stakeholders' collaboration and communication	Kiparsky et al. (2016); Kakwani and Kalbar (2020); Salminen et al. (2021)
	Challenges to attribute roles and responsibilities among stakeholders	Savini and Giezen (2020)
	Restricted stakeholders' engagement in the decision-making process	Šteflová et al. (2018)
	Limited awareness of benefits	Mbavarira and Grimm (2021)
	Limited predictability of future regulations	Salminen et al. (2021)

1.4 The Acceptance Perspective

The understanding of the perceptions that a wide range of stakeholders' (e.g., the public, government, industry) associate with CE applications in the water sector has primarily focused on the acceptance perspective. An acceptance perspective characterises factors that drive or hinder the acceptance, development, and uptake of CE applications (Govindan & Hasanagic, 2018). The literature on the CE has extensively built on the identification of factors that drive and challenge the diffusion of the CE (Govindan and Hasanagic 2018; de Jesus and Mendonça 2018; Kakwani and Kalbar 2020; Kevin van Langen et al. 2021; Mainardis et al. 2022). As with all such binary perspectives, looking at acceptance is attractive since it provides mental clarity as to who identifies as opponents and proponents and what elements are likely to hamper CE diffusion (Ashforth, 2019). An acceptance perspective partly relies on the deficit model, or passive acceptance of expert information. This often persists because scientists are not

always trained to be effective communicators. They often assume that the public processes information in a rational manner and see the public as another entity creating an “us-them” hierarchy which may limit meaningful interactions and infer that non-scientists are not part of the debate (Simis et al., 2016, p. 408). Moreover, the deficit model provides a simplistic and straightforward policy solution (e.g., education) to a pinpointed problem (e.g., stakeholder lack of knowledge) that leads to a lack of support for science (Simis et al., 2016). Although raising awareness through active communication is critical to a successful CE (Smol et al., 2018; Villarín & Merel, 2020), solutions such as education campaigns are not always sufficient to generate ideas of support for CE applications because decisions to ‘accept’ a technology are not always rational processes (Harris-Lovett et al., 2015; Smith et al., 2018). Moreover, given that the popularisation of the CE is partly shaped by non-academic institutions and actors such as the Ellen MacArthur Foundation charity (Salminen et al., 2021), there are opportunities to think more comprehensibly about approaches to stakeholders’ involvement. These can include the involvement of institutions and communities in participatory practices with continuous active communication (Miranda et al., 2022; Smith et al., 2018; Villarín & Merel, 2020), that develop new social and cultural norms (Williams, 2019). Including different perspectives, needs, and interests, through communities of practice for instance, is important for discussing CE applications in their institutional context and ultimately for the success of the water sector’s role in the CE (Fulgenzi et al., 2020).

The acceptance perspective treats CE applications in isolation from institutions, and the outcome of such perspective is binary: approval or dismissal. It has been argued that understanding perceptions towards CE applications, such as water reuse, may require a more nuanced and comprehensive approach, as a layered process of connections between individuals and technology taking place in norm-based spheres (Al-Saidi, 2021). The perceptions of CE applications may be understood as part of a complex socio-technical system in which technologies interact with societal norms and institutions in a complex and perhaps irrational development process (Harris-Lovett et al., 2015).

1.5 Introduction to Legitimacy Theory

The social representation of CE applications in the water sector, such as water reuse, is likely to be driven by contextual elements (Smith et al., 2018). In other words, responses to CE applications are complex, and a closer look at the institutional intricacies that foster perceptions is required. Legitimacy Theory is central to Institutional Theory and offers a holistic approach to studying societal perceptions. Institutional Theory is concerned with the understanding of how actors operate in relation to higher-order structures like societal norms and cultures (Fuenfschilling & Truffer, 2016). Whilst the CE literature adopted Institutional Theory (Do et al., 2022; Ranta et al., 2018; Wang et al., 2014), there is limited understanding of the legitimacy of CE applications.

Legitimacy is defined as the alignment of an entity's activities with values, norms, definitions, and beliefs that prevail in a given institutional system at a given point in time (Suchman, 1995). Legitimation, on the other hand, is concerned with the mechanisms or processes used to build and maintain legitimacy over time (Suddaby et al., 2017). Legitimacy provides an understanding of decision-making that is distinct from "means-ends rationality" (Zimmerman & Zeitz, 2002, p. 416). When one questions whether a given organisation or technology is the best option, one refers to the prescribed norms and values to decide whether the entity is legitimate (Zimmerman & Zeitz, 2002). Additionally, legitimacy is vital for accessing resources such as financial assets, market access and government approval (Aldrich & Fiol, 1994), which is critical to the emergence, diffusion and survival of organisations and technologies and hence to the innovation process (Bergek et al., 2008; Hekkert et al., 2007).

Legitimacy Theory built on the Management, Institutional and Stakeholder Theories (Delgado & Castelo, 2013) and has been used in organisation studies, political science, philosophy, sociology, and psychology (Lieder & Rashid, 2016). Legitimacy can be attributed to various entities, such as organisations and technologies (Aldrich & Fiol, 1994). To build on the extensive use of Legitimacy Theory in organisation studies, scholars have recently studied legitimacy in the

context of a wide range of environmental technologies, including water reuse (Binz et al., 2016; Harris-Lovett et al., 2015) and nutrients recovery (Blankesteijn & Bossink, 2020).

1.6 Thesis' perspective on legitimacy

In this thesis, legitimacy first exists because it resides "in the eyes of the beholder" (Ashforth & Gibbs, 1990, p. 177). This research provides empirical evidence of 'snapshots' of perceptions associated with legitimacy at a given point in time whilst reflecting on how to build and maintain legitimacy in the recommendations section. A process of legitimation entails that water, nutrients, and energy derived from industrial and municipal wastewater would ultimately become "normalised" and as desirable as conventional sources (Smith et al., 2018). Moreover, the legitimation process would aim to build public and stakeholders' trust, not only in the technology but also in the organisations responsible for the design and management of CE applications (Binz et al., 2016; Harris-Lovett et al., 2015; Suchman, 1995).

1.7 Research gaps, aim, and objectives

The literature review in Chapter 2 identified research gaps that were addressed in this thesis. Knowledge gaps related to (1) a lack of in-depth and nuanced understanding of societal-based and cultural-based factors in the CE literature, (2) a limited understanding of whether CE applications can be perceived as legitimate, (3) a limited understanding of whether contemporary cases of water-centric CE applications can be perceived as legitimate or if legitimacy can only be acknowledged in retrospect like it is the case in historical studies, and (4) a limited understanding of whether legitimacy perceptions apply beyond individual CE applications to a combination of water reuse, nutrients and energy recovery among a wide range of stakeholders.

To address these gaps, the aim of this thesis was to extend the prevalent conceptual perspective on legitimacy to CE applications relevant to the water sector, including water reuse, nutrients and energy recovery, and understand

legitimacy through perceptions of water-centric CE applications. This study was underpinned by a tailored framework to evaluate perceptions associated with four legitimacy categories: moral, cognitive, pragmatic, and regulatory. A qualitative and case study research design was employed to interview 44 case study stakeholders and 12 members of the public. Using a thematic analysis, which was mainly deductive, and inductive to a lesser extent, this thesis provided evidence of stakeholders' perceptions of three contemporary European case studies embedding CE applications, and public perceptions of hypothetical CE applications.

This study makes two theoretical contributions, and many practical recommendations. First, findings provide a complementary view to an acceptance perspective for the CE literature by providing a non-binary, in-depth, and nuanced view of perceptions associated with CE applications. Second, a theoretical contribution is made by extending the interpretation of legitimacy in a CE context, and challenging existing knowledge on legitimacy by providing a non-linear, complex, and context-dependent view on legitimation processes. Third, practical recommendations are formulated for outreach managers, regulators and the government, and prospective companies, and are based on using the legitimacy framework as a diagnostic tool to build specific legitimacy categories. The following objectives were formulated to address the aim of the study:

Objective 1: To identify what aspects of legitimacy are utilised by stakeholders in describing their perceptions of real-world CE applications across different case studies.

- 1a. To identify different categories of legitimacy emerging from the judgement of CE applications.
- 1b. To identify linkages between legitimacy categories.

Objective 2: To identify what aspects of legitimacy are utilised by the public in describing their perceptions of hypothetical CE applications.

- 2a. To identify different categories of legitimacy emerging from the judgement of CE applications.
- 2b. To identify linkages between legitimacy categories.

Objective 3: To understand and explain the extent to which one connects local CE applications with other CE applications.

Objective 4: To use the acquired knowledge to reflect on general and CE-specific aspects of legitimation processes and to provide recommendations that may advance the legitimation of CE applications.

- 4a. To reflect on general and CE-specific aspects of legitimation processes.
- 4b. To provide recommendations for outreach managers, regulators and governments, and prospective companies that may advance the legitimation of CE applications.

1.8 Thesis plan and interactions between the chapters and the objectives

This thesis examines the societal legitimacy of a water-centric CE applications across seven chapters. Figure 1 illustrates the sequence of the thesis chapters and the interactions between the chapters and the research objectives. Table 2 provides a summary of the chapters, case studies, type of data, outputs, and method that are used to address the individual objectives of the thesis.

Chapter 1 grounds the thesis in the broader literature and introduces the concepts of CE and legitimacy, and their associated challenges. The introduction details the relevance of studying societal perceptions towards a CE for the water sector. The aim and objectives of the thesis are detailed, followed by a description of the interactions between the thesis chapters and research objectives.

Chapter 2 reviews the literature on the CE and legitimacy. It first outlines how perceptions have been understood in the CE literature as part of an acceptance perspective and how a legitimacy perspective can provide a complementary view to the understanding of perceptions associated with CE applications. Second, this chapter critically assesses different legitimacy perspectives and frameworks in the literature looking at the legitimacy of organisations and environmental technologies and rationalises the chosen approach. Finally, this chapter tailors a typology based on four legitimacy categories: moral, cognitive, pragmatic, and regulatory. Chapter 2 provides the foundation for the development of the method presented in Chapter 3.

Chapter 3 details the qualitative and case study research design taken in the thesis and presents the three contemporary case studies used to explore the perceptions of cases study stakeholders. It then describes the process of interviewees' selection. This chapter outlines the topic guides used to interview two types of interviewees: cases study stakeholders and members of the public. Finally, this chapter presents the thematic analysis used to extract perceptions from interviews and connect them with legitimacy categories. The method provided in Chapter 3 is employed to generate empirical evidence in Chapters 4 and 5.

Chapters 4 and 5 detail the perceptions of case study stakeholders towards three contemporary cases of CE applications across 44 interviews (Objective 1), and perceptions of the public towards hypothetical CE applications across 12 interviews (Objective 2), respectively. These chapters report on the perceptions associated with the four legitimacy categories, as well as the relative levels of legitimacy categories and the linkages between them.

Chapter 6 discusses the results from Chapters 4 and 5 in relation with the CE and legitimacy literature.

Finally, Chapter 7 details how this work addresses the objectives and research gaps set in Chapters 1 and 2, respectively. It also outlines the contributions to

knowledge made by the thesis, as well as the study limitations, further research opportunities and conclusions.

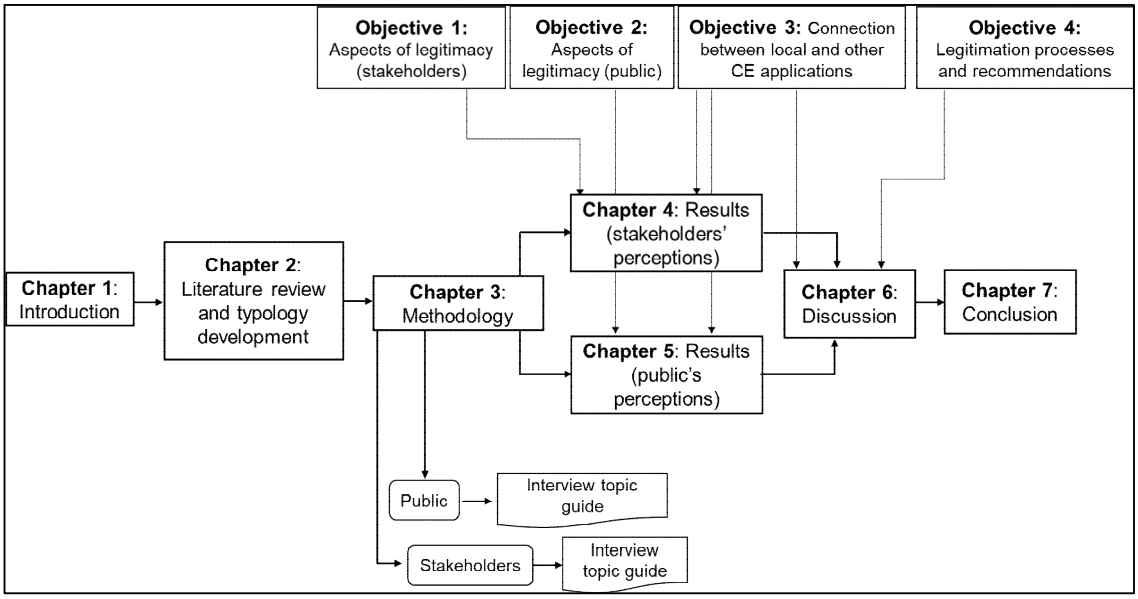


Figure 1 – Sequence of the thesis chapters, and interactions between the chapters and the objectives

Table 2 – Summary of the chapters, case studies, type of data, outputs and method addressing the individual objectives of the thesis

Objective	Chapter	Case study	Data	Output	Method
Objective 1 – Legitimacy aspects in stakeholders' interviews	4	A (SE) B (NE) C (UK)	Predominant and content of legitimacy categories and links between them	A (n=21) B (n=11) C (n=12)	Semi-structured interviews, thematic analysis (deductive and inductive)
Objective 2 – Legitimacy aspects in public interviews	5	C (UK)		C (n=12)	
Objective 3 – Connection between local and other CE applications	4, 5	All	Reference to cognitive legitimacy	Public and stakeholders' interviews (n=56)	
Objective 4 – Legitimation processes and recommendations	4, 5, 6, 7	All	Growing legitimacy categories, challenge of existing knowledge on legitimation, set of recommendations that address weak and foster stronger legitimacy categories.	Public and stakeholders' interviews (n=56)	

2 LITERATURE REVIEW

The literature review was set out to answer three questions: (1) “How may a legitimacy perspective provide a complementary view to an acceptance perspective?”; (2) “What legitimacy perspective and framework are the most appropriate to understand the perceptions of CE applications?” and (3) “How has legitimacy been applied in environmental technologies studies?”. To answer these questions, this chapter first outlined how perceptions have been understood in the CE literature as part of an acceptance perspective and how a legitimacy perspective can provide a complementary view for the understanding of perceptions associated with CE applications. Second, this chapter critically assessed different legitimacy perspectives and frameworks in the literature looking at the legitimacy of organisations and environmental technologies and rationalised the chosen approach. Finally, this chapter tailored a typology based on four legitimacy categories: moral, cognitive, pragmatic, and regulatory legitimacy. A summary of the constructs utilised in the literature review is displayed in Table 3.

Table 3 – List of the constructs used in the literature review, and their definition and location in the text

Construct	Definition	Location in the text
Acceptance perspective	Perspective that enumerates individual factors that drive or hinder the acceptance, development and uptake of CE applications.	Section 2.1
Institutional Theory	Concerned with the understanding of how actors operate in relation to higher-order structures, like societal norms and cultures, and is legitimacy seeking.	Section 2.3 and Figure 3
Legitimacy Theory	Generalised perceptions that an organisation or a technology is appropriate given a system of norms.	Section 2.4 and Figure 3
Normative approach	Defines a predefined set of legitimacy criteria that needs to be objectively complied with.	Section 0 and Table 4

Construct	Definition	Location in the text
Sociological approach	Defines a subjective evaluation of legitimacy.	Sections 2.4.2 and 2.4.3, and Table 4
Legitimacy-as-property, process, and perception	Legitimacy-as-property: Legitimacy is possessed.	Section 2.4.2
	Legitimacy-as-process: Legitimacy as built by social actors.	
	Legitimacy-as-perception: Legitimacy as being a form of socio-cognitive perceptions.	
Legitimacy framework	Set of legitimacy categories.	Sections 2.4.2 and 2.4.4, and Table 4
Legitimacy typology	Chosen set of legitimacy categories used in the thesis.	Sections 2.4.4, 0, 2.4.6, 2.4.7, 2.4.8, 2.4.9
Sources of legitimacy	Sources that address legitimacy categories, such as perceptions, actions, and attributes.	Section 2.4.3

2.1 Acceptance perspective

Perceptions of CE applications have been extensively explored using an acceptance perspective. The acceptance perspective enumerates individual factors, including social, cultural, and institutional factors, that drive or hinder the acceptance, development, and uptake of CE applications (Govindan & Hasanagic, 2018). This perspective has been applied in many contexts and sectors. Applications include municipal waste recycling (Polyportis, Mugge, and Magnier 2022), water reuse (Lahlou et al., 2021; Lee & Jepson, 2020; Mainardis et al., 2022; Stenekes et al., 2006), energy generation including nuclear fusion (Čábelková et al. 2021) and waste-to-energy process (Achillas et al. 2011). Acceptance of CE applications has been studied among various stakeholders, such as the public (Aitken et al., 2014), businesses (Kirchherr et al. 2018),

practitioners (Kolade et al. 2022), local communities (Kolade et al. 2022), and consumers (Botelho et al., 2016; Mugge et al., 2017).

More broadly, studies looking at the CE have extensively built on the identification of factors, including social, cultural, and institutional factors, that drive and challenge CE diffusion (Govindan and Hasanagic 2018; de Jesus and Mendonça 2018; Kakwani and Kalbar 2020; Kevin van Langen et al. 2021; Mainardis et al., 2022). These studies also included those that rank factors to identify the most and least important ones for interviewees (Bischel et al. 2012) and indicate the chain of relationships between factors (Bischel et al., 2012; Kirchherr et al., 2018).

Among many factors influencing the acceptance or the development of CE applications, this work draws attention to societal and cultural-based factors. These factors are particularly relevant to look at since they are one of the major hindrances to the development of the CE (Bischel et al., 2012; Kakwani & Kalbar, 2020; Kirchherr et al., 2018). For instance, public (Mainardis et al., 2022) and stakeholders (Bischel et al., 2012; Mainardis et al., 2022) perceptions, as well as social attitudes are often cited as a barrier to the development of the CE. Yet, the understanding of societal-based factors and particularly of stakeholders' perceptions in the context of CE applications in the water sector has been under-explored and requires further investigation (Gherghel et al., 2019; Kakwani & Kalbar, 2020; Mainardis et al., 2022; Villarín & Merel, 2020).

2.2 A legitimacy perspective to provide a complementary view to the understanding of perceptions towards CE applications

An emerging stream of literature has looked at perceptions of environmental technologies, including CE applications (e.g., water reuse), as inherently part of a broader societal process of technology legitimation (Binz et al., 2016; Harris-Lovett et al., 2015). Legitimacy is understood as the perception that an organisation or a technology is appropriate and desirable given a system of values, beliefs, and norms (Suchman, 1995). This section describes the potential of a legitimacy perspective to provide a complementary view to an acceptance one by providing a more comprehensive, in-depth, and nuanced understanding

of perceptions towards CE applications. Finally, this section describes the usefulness of legitimacy in accessing resources that are essential for the development of CE applications.

Whilst an acceptance perspective considers factors that foster the acceptance of CE applications, in which factors and CE applications are treated as two separate entities (Rohe & Chlebna, 2021), a legitimacy approach can provide a comprehensive understanding of CE applications by embedding them in their institutional contexts. It has been argued that technologies, such as CE applications, cannot develop in isolation from and without an understanding of the institutional and social contexts (Al-Saidi, 2021; Henrysson & Nuur, 2021; Kiparsky et al., 2013). CE applications, such as water reuse, are “socially charged” topics that are influenced by many stakeholders and contextual factors (Smith et al., 2018, p. 46). For instance, in Belize, Central America, the local understanding of nutrients and energy recovery from wastewater was influenced by broader cultural practices, and contemporary economic and political challenges (Wells et al., 2016).

An acceptance perspective tends to look at the target audience separately from the CE applications. It has been argued that the popularisation of the CE is actively shaped by various actors, including non-academic institutions and actors such as the Ellen MacArthur Foundation charity (Salminen et al., 2021), who form perceptions based on societal expectations (Smith et al., 2018). The inclusion of different perspectives needs and, interests is essential for discussing CE applications in their institutional context and ultimately for the success of the role of the water sector in the CE because it creates a shared understanding and vision (Fulgenzi et al., 2020). Legitimacy has the potential to show the influence of a wide range of stakeholders on the development of CE applications. For instance, one of its components, ‘influence legitimacy’, can show a shared decision-making between adopting companies and their end-users (Harris-Lovett et al., 2015; Suchman, 1995).

Because different actors are likely to have different perceptions of CE applications, they may express a more comprehensive range of perceptions when compared to the binary decision of accepting or rejecting a technology. Although this dichotomy is attractive since it provides clarity as to who identifies as opponents and proponents (Ashforth, 2019), a legitimacy perspective has the potential to provide a more in-depth understanding of perceptions of CE applications and a comprehensive range of perceptions, including perceptions that relate to social norms (e.g., CE applications are the right thing to do), cultural and (e.g., CE applications are inevitable), pragmatic aspects (e.g., CE applications are beneficial), and regulations (e.g., CE applications conform with regulations) (Binz et al., 2016; Harris-Lovett et al., 2015; Suchman, 1995).

Moreover, a legitimacy perspective may also provide a more nuanced understanding of these multiple perceptions. Different actors often have nuanced and contradictory perceptions (Ashforth, 2019) about CE applications, which a legitimacy perspective can capture by reflecting on the relative level and strength of perceptions of CE applications. For instance, elements associated with social norms (e.g., employees' perceptions that sustainability is the ultimate direction of the company's future) and regulations (e.g., the responsibility of the management team to establish sustainable commitments and policies) played a major role in driving the internal legitimation of renewable activities in an oil and gas company, whilst cultural elements were less predominant (Jaber & Oftedal, 2020).

Finally, legitimacy is essential to develop new technologies like CE applications because they interact with sceptical resource holders, such as customers and suppliers, due to the technology's lack of credibility, familiarity (Aldrich & Fiol, 1994) and historical record of performance (Zimmerman & Zeitz, 2002). Their motivation to provide resources is derived from their perceptions that an entity is competent, worthy, appropriate, effective and desirable (Zimmerman & Zeitz, 2002). Hence, legitimacy is crucial for acquiring resources such as financial assets, market access, and government approval (Aldrich & Fiol, 1994), which in turn are essential to support a new technology's emergence, diffusion, and

survival (Markard et al., 2016; Zimmerman & Zeitz, 2002). In other words, legitimacy is crucial to guaranteeing the success of a technology.

2.3 The Legitimacy and Institutional Theories

Legitimacy Theory built on Institutional and Stakeholders' Theories. Whilst the CE literature has adopted Stakeholders' (Chiappetta Jabbour et al., 2020), Institutional (Do et al., 2022; Ranta et al., 2018; Wang et al., 2014) and Neo-Institutional Theories (Dagiliene et al., 2020), Legitimacy Theory has had limited application in the CE literature (Zheng et al., 2022), which highlighted opportunities to understand the legitimacy of the CE applications.

Legitimacy and Institutional Theories are closely related (Figure 2). Whilst the economic branch of Institutional Theory states that actors seek efficiency (Haunschild & Miner, 1997), the sociological branch states that actors seek legitimacy through many mechanisms (DiMaggio & Powell, 1983), and forms the foundations for Legitimacy Theory. These mechanisms were later framed as institutional works, that create, maintain, and disrupt institutions and legitimacy (Lawrence and Suddaby, 2006; Binz *et al.*, 2016; Fuenfschilling and Truffer, 2016). These include, for instance, 'constructing identities', which entails defining the relationship between actors and their field (Fuenfschilling & Truffer, 2016). Among the institutional works, some specifically relate to the legitimation process, or legitimacy category building, such as, 'mimicry' which entails actions that mesh the entity to be legitimised with daily life experiences, which refers to cognitive legitimacy, or 'educating' which builds cognitive and pragmatic legitimacy (Binz et al., 2016; Fuenfschilling & Truffer, 2016). Institutional works or legitimation process will hereafter be referred to as legitimacy-as-process (see Section 2.4.2). Whilst legitimacy categories were derived from institutional pillars – namely normative, cultural-cognitive, and regulative (Scott, 1995), the perspectives employed in Legitimacy and Institutional Theories differ. Institutional Theory conceptualises how actors operate and respond to pressures in technological fields to build legitimacy in relation to higher-order normative, cognitive, and regulative structures like values and norms (Fuenfschilling & Truffer, 2016).

Legitimacy Theory refers to the perceived appropriateness of CE applications with regard to a set of values and norms that prevail in the society (Suchman, 1995).

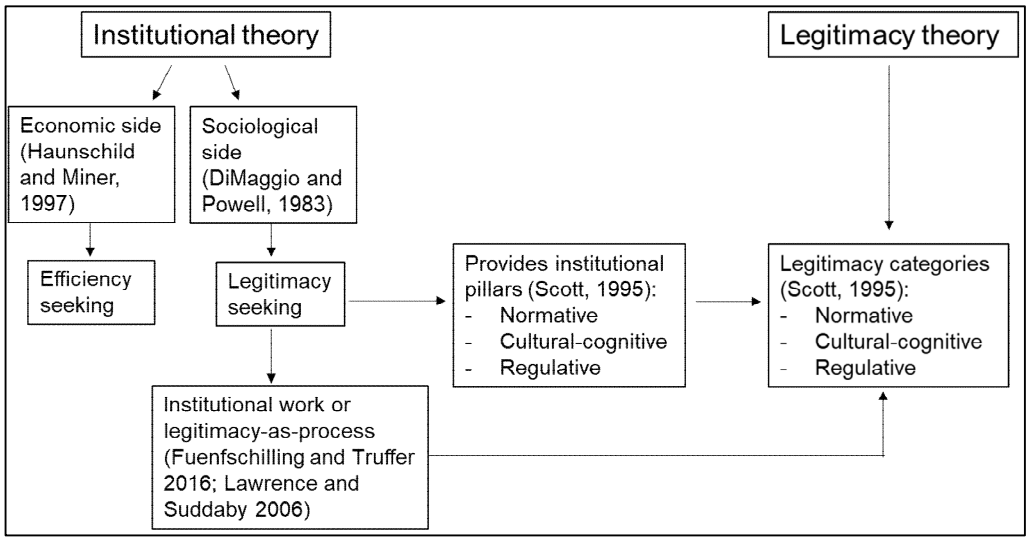


Figure 2 – Relationship between Institutional and Legitimacy Theories

2.4 Legitimacy Theory

Legitimacy Theory has roots in Weber's (1978) work, which offers central legitimacy insights that are echoed in many approaches and frameworks. There are many ways to study legitimacy. The following sections introduced and critically assessed (1) the normative and sociological approaches (Sections 0 and 2.4.2), (2) multiple legitimacy frameworks (Sections 0 and 2.4.2), and (3) the legitimacy-as-property, legitimacy-as-process, and legitimacy-as-perception perspectives (Section 2.4.2). Section 2.4.3 detailed where the thesis stands in between the legitimacy-as-property, legitimacy-as-process, and legitimacy-as-perception perspectives, whilst sections 2.4.4 and 0 reflected on numerous frameworks and legitimacy categories to tailor the framework of the thesis. A summary of the frameworks that have been applied to organisations, technologies, and governance is presented in Table 4. Frameworks were numbered from one to four in Table 4 and are referred to in Table 6 in Section 2.4.2. Figure 3 summarises the relationship between the Institutional and Legitimacy Theories, and the schools of thought on the Legitimacy Theory.

Table 4 – List of the frameworks and categories applied in the normative and sociological approaches to legitimacy and their empirical applications

Approach	Framework and category	Application	Author	Empirical application
Normative	Input and output legitimacy	Governance	Scharpf (1999)	O'Donnell et al. (2019)
	Input, throughput, and output legitimacy	Governance	Schmidt (Schmidt, 2013); Stupak et al (2021)	Blankesteijn and Bossink (2020); Boon, Sandstrom and Christian (2022); Gearey and Jeffrey (2006); O'Donnell et al. (2019); Stupak et al. (2021)
Sociological	Socio-political and cognitive legitimacy (framework 1)	Organisation	Aldrich and Fiol (1994)	Hall et al. (2014)
	Moral, cognitive, and pragmatic legitimacy (framework 2)	Organisation and environmental technology	Suchman (1995)	Harris et al. (2015)
	Normative, cognitive, and regulative (framework 3)	Organisation	Scott (1995)	Markard et al. (2016)
	Normative, cognitive, regulative, and pragmatic (framework 4)	Environmental technology	Scott (1995); Suchman (1995)	Binz et al. (2016)

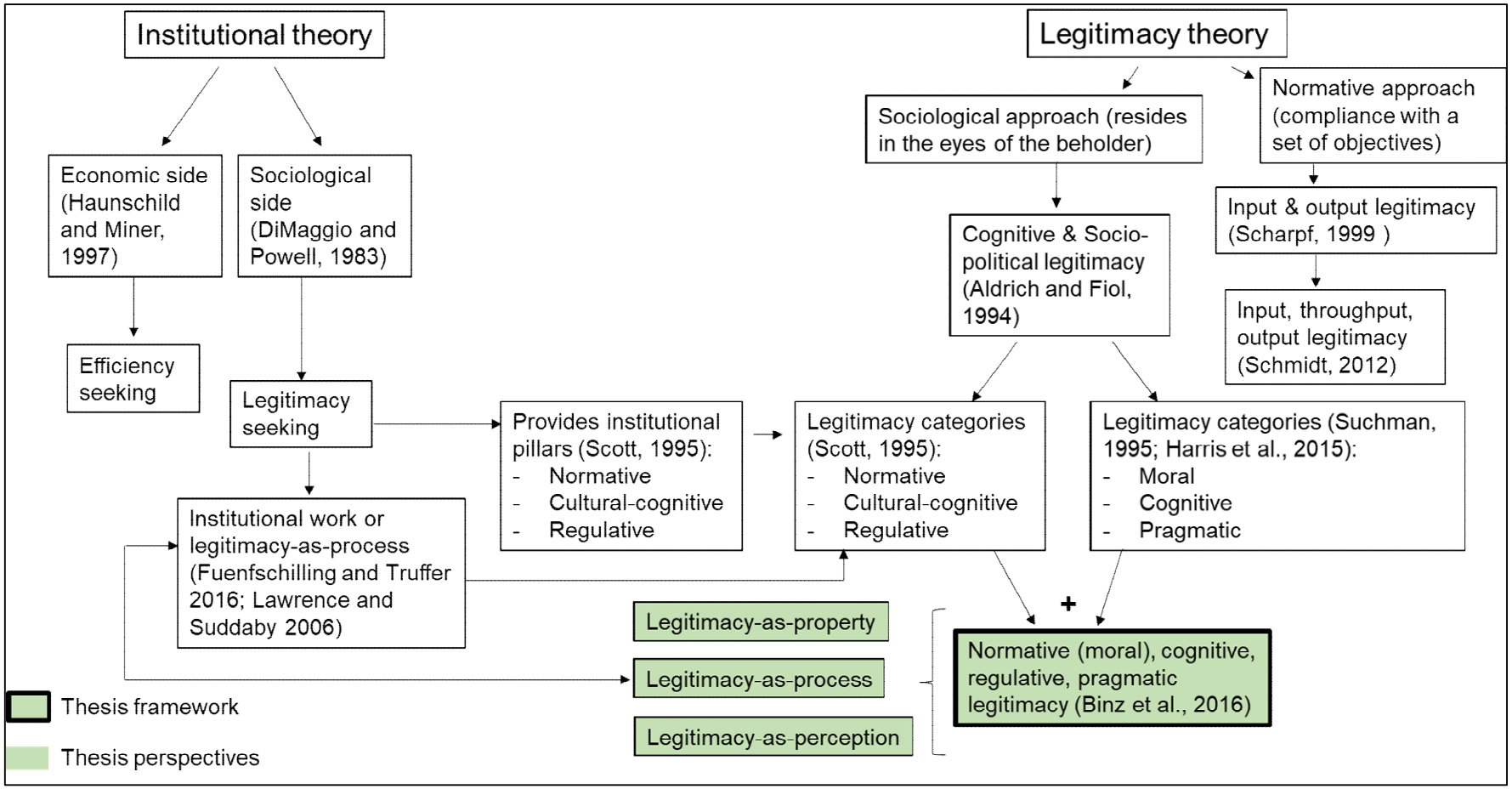


Figure 3 – Summary of the schools of thought on Institutional and Legitimacy Theories, the relationship between the two and the approach and framework chosen for the thesis

Legitimacy can be attributed to a variety of entities (Johnson, 2004). The theoretical foundation of Legitimacy Theory lies in organisation studies (Aldrich & Fiol, 1994), in which the theory has been applied extensively. Studies looking at the legitimacy of technologies and, particularly of environmental technologies have flourished in the past few years. However, only three studies looked at the legitimacy of CE applications in the water sector, and none of them looked at the legitimacy of water reuse, nutrients and energy recovery applications combined. In this section, the core Legitimacy Theory developed in organisation studies was put in dialogue with studies looking at the legitimacy of environmental technologies. To a lesser extent, studies looking at the legitimacy of environmental activities (Jaber & Oftedal, 2020) and governance of sustainability (Stupak et al., 2021), agricultural transition (Boon et al., 2022) and water (Edwards, 2016; Gearey & Jeffrey, 2006; O'Donnell et al., 2019) also contributed to the discussion.

2.4.1 A normative approach to legitimacy

In the literature, Legitimacy Theory was explored using two different approaches: a normative and sociological approaches (Table 4). A normative approach states that to achieve legitimacy, a predefined set of criteria, which are objectively assessed, needs to be complied with (Boon et al., 2022; Schmidt, 2013). One normative approach differentiates input from output legitimacy in governance topics in Europe (Scharpf, 1999) (Table 5). Input legitimacy refers to the participatory process that leads to the formulation of rules and laws, whilst output legitimacy refers to the problem-solving quality of rules and laws. Whilst the input corporate strategy and output legitimacy taken alone provide a linear and binary way of linking a problem to a solution, which closely relate to an acceptance perspective, throughput legitimacy has been developed to provide normative criteria that are empirically relevant. Throughput legitimacy was added to reflect the quality of complex processes happening inside the "black box" of EU governance based on their accountability, efficacity, transparency, openness, and inclusiveness (Schmidt, 2013, p. 5; Schmidt & Wood, 2019).

Table 5 – Definitions of the legitimacy categories of the input, throughput, output framework

Category	Definition	Author
Input	Participatory process that leads to the formulation of rules.	Scharpf (1999); Gearey and Jeffrey (2006); Boon et al. (2022)
Throughput	Complex processes happening inside the “black box” of EU governance.	Schmidt (2013)
Output	Problem-solving quality of rules. Refers to whether a goal has been reached.	Scharpf (1999); Gearey and Jeffrey (2006); Boon et al. (2022)

Despite throughput legitimacy adding a more empirical dimension to the framework, the normative approach is challenged by a sociological approach that states that legitimacy “resides in the eye of the beholder” (Ashforth & Gibbs, 1990, p. 177). For instance, studies looking at the legitimacy of environmental technologies heavily relied on indicators and criteria that need to be matched to reach input, throughput and output legitimacy and thus reflected a low perceptual degree. The few perceptual elements included in such studies mainly refer to input legitimacy and cover, for example, the gathering of satisfaction data from stakeholders with regard to their involvement in decision-making processes (Stupak et al., 2021).

A sociological or perceptual approach has more recently been applied to the input, throughput, and output framework, in addition to the normative approach, in the context of an agricultural transition. The association of pre-set criteria (normative) with an evaluation of perceived legitimacy (sociological) allowed to assess perceptions in a ‘real-world’ situation and to gain insights into what was actually perceived as legitimate in practice. For instance, the two approaches revealed the importance of recognising all underlying sources of the problems which were reflected by diverse stakeholders’ perceptions, and thus addressing the problems in the eyes of the stakeholders (Suchman, 1995), rather than

formulating a parsimonious problem in the development of input legitimacy (Boon et al., 2022).

Three additional elements argued for a sociological approach for this study. First, the input, throughput, and output framework depicted in environmental technologies studies provided insights and highlighted improvement opportunities in the regulatory, communication, engagement, and participatory, as well as procedural and consequential (i.e., principles to follow, monitoring, output) aspects of legitimacy, which left little space for subjective elements to emerge (Stupak et al., 2021). Indeed, such elements tend to be rules or actions imposed to various stakeholders and reflect little subjective interpretation. Second, it was argued that the social, economic, and institutional contexts, and the purpose for which policies are developed matter (Boon et al., 2022; O'Donnell et al., 2019; Stupak et al., 2021), as opposed to isolating the development process of policies from their contexts. Finally, legitimacy is a condition that needs to be sustained rather than solely an output to be delivered (Gearey & Jeffrey, 2006; O'Donnell et al., 2019). Addressing those three elements, CE applications may benefit from understanding the more subjective, contextual, and deeply engrained aspects of legitimacy, namely, moral (i.e., societal values and norms) and cognitive-cultural (i.e., cultures, routines) legitimacy that sociological frameworks offer (Scott, 1995; Suchman, 1995), as opposed to the 'easy fix' of participatory and regulatory aspects. Indeed, societal values, norms, cultures, and daily-life routines are more likely to be subjectively and socially constructed and assessed when compared to imposed actions and rules. Together, these arguments led to the adoption of a sociological approach for this work, to look at the perceived desirability and appropriateness of CE applications in a given institutional context (Suchman, 1995), which directly fits the aim of the study.

2.4.2 A sociological approach to legitimacy

The sociological approach has been extensively applied in organisational studies (Aldrich & Fiol, 1994; Scott, 1995; Suchman, 1995). As it was mentioned at the beginning of Section 2.4, studies looking at the legitimacy of environmental

technologies have flourished in the past few years. In this context, Legitimacy Theory has mainly been applied to renewable energy-generating technologies, such as biogas and wind power, at the expense of other technologies, such as food and agricultural technologies, and CE applications (Table 6). With regard to CE applications and to water-centric CE applications in particular, the legitimacy framework only applied to water reuse individually in two papers (Harris-Lovett *et al.*, 2015; Binz *et al.*, 2016) and neglected the incorporation of nutrients and energy recovery or multi-applications. Although technologies can operate in an isolated manner, it becomes beneficial to associate multiple CE applications, like water, nutrients, and energy reuse and recovery, as part of industrial symbioses for instance, in that it decreases companies' costs for resources, reduces waste generation, and builds new collaborations (Domenech et al., 2019). Therefore, there are opportunities to understand how legitimate these fruitful associations are. Finally, studies of environmental technologies have mainly approached legitimacy using retrospective or historical analyses by primarily employing secondary data through media analyses.

Table 6 – Applications of multiple legitimacy frameworks in the literature on environmental technologies, renewable and sustainable activities, and water governance

Author	Fram. 1	Fram. 2	Fram. 3	Fram. 4	Type of technology and governance
Binz et al. (2016)**				X	Water reuse technology
Dahabieh et al. (2018)	X				Food and agricultural technology
Dehler et al. (2022)*				X	Wind power technology
Edwards et al. (2016)**		X			Water governance organisations
Geels and Verhees (2011)*	Cultural legitimacy (equated to normative and cognitive legitimacy)				Nuclear energy technology
Harris et al. (2015)**		X			Water reuse

Author	Fram. 1	Fram. 2	Fram. 3	Fram. 4	Type of technology and governance
Jaber et al. (2020)*			X		Renewable energy activities
Jansma et al. (2019)				X	Genetically modified food technology
Lempiälä et al. (2019)*	Cultural resonance (equated to normative and cognitive legitimacy)				Solar technology
Mackinnon et al. (2022)	Pragmatic legitimacy only				Floating wind power technology
Markard et al. (2016)*			X		Biogas technology
Rohe et al. (2021)*		X			Onshore wind energy technology
Van der Velden et al. (2022)				X	Ammonia emission-reducing technology

Studies looking at the legitimacy of *energy and **water technology; in grey are studies looking at the legitimacy of governance; Fram. abbreviates Framework. Fram. 1-4 were introduced in Table 4.

A sociological approach offers many ways to apprehend legitimacy (Figure 3). The literature differentiated the legitimacy-as-property, legitimacy-as-process and legitimacy-as-perception perspectives (Suddaby et al., 2017, p. 451). Legitimacy-as-property focuses on the property or possessed legitimacy of CE applications (i.e., fit between CE applications and their context) as an outcome and is the closest of the three perspectives to a normative approach. This approach provides many legitimacy categories falling under legitimacy frameworks used across the three perspectives (discussed in Section 2.4.4). Legitimacy-as-process or legitimation refers to the process, including the strategies and actions of actors, through which the legitimacy of an entity happens. The strategies and actions that actors employ to create and maintain legitimacy can be conceptualised as forms of institutional work, as introduced in section 2.3 (Binz et al., 2016; Fuenfschilling & Truffer, 2016; Lawrence & Suddaby, 2006). Finally, legitimacy-as-perception looks at the individual process of assessment or judgment of social entities (Suddaby et al., 2017, p. 451).

Similarly, the literature looking at the legitimacy of environmental technologies conceptualised legitimacy as the perceived fit of biogas technology with its institutional context (legitimacy-as-property) (Markard et al., 2016), and as part of a long-term legitimation process of water reuse (legitimacy-as-process) (Binz et al., 2016). Although each study had one dominant legitimacy perspective, the majority of them looked at the legitimacy of environmental technologies with a combination of more than one perspective (Harris-Lovett et al. 2015). For example, a study combined legitimacy-as-perception, legitimacy-as-property and legitimacy-as-process by exploring the perceptions of employees on actions taken by an oil and gas company towards renewable energy practices according to three legitimacy categories (Jaber & Oftedal, 2020). Such configurations served the understanding of legitimacy in that they identified perceptions (legitimacy-as-perception) of what 'composes' legitimacy by exploring the sources of different legitimacy categories (legitimacy-as-property), and how they were created through complex processes (legitimacy-as-process).

2.4.3 Thesis' perspective on legitimacy

The thesis adopted elements from all three perspectives: legitimacy-as-perception, legitimacy-as-property, and legitimacy-as-process (Figure 4 and Table 7). This research primarily encompassed that legitimacy exists because it resides "in the eyes of the beholder", which followed a legitimacy-as-perception perspective (Ashforth & Gibbs, 1990, p. 177; Suddaby et al., 2017). This perspective has received little attention in the literature looking at the legitimacy of organisations and environmental technologies. Legitimacy-as-perception was, therefore, the dominant perspective and the point of departure for the incorporation of the two other perspectives. First, this research captured perceptions of possessed properties associated with legitimacy categories (legitimacy-as-property). In the literature, a legitimacy-as-property perspective referred to possessed legitimacy in a binary fashion (Suddaby et al., 2017). This research provided a nuanced understanding of what legitimacy categories were elicited in perceptions of CE applications and at what level. Second, this study focused on perceptions of stakeholders' actions and strategies to create

legitimacy (legitimacy-as-process). Whilst a legitimacy-as-perception perspective focuses on perceptions of an individual (Suddaby et al., 2017), this research aggregated perceptions of individuals at a collective level. Combining a legitimacy-as-process perspective, which tends to create an artificial division between actors who act and the audience, with a legitimacy-as-perception perspective allowed to recognise the diversity of evaluators and their perceptions of actions and strategies.

In summary, this work captured perceptions of actions and possessed properties of CE applications that were associated with legitimacy categories (see Section 2.4.4) at a case study or community level and at a given point in time; Perceptions of different stakeholders that are sources of legitimacy categories interact in complex ways and aggregate to form a legitimacy 'picture', or 'landscape', or overall legitimacy. That is, CE applications can be perceived as fitting socially established customs or practices (moral legitimacy), benefiting and including a wide range of stakeholders in decision-making activities (pragmatic legitimacy), understandable and not questioned (cognitive legitimacy), and/or complying with regulations (regulatory legitimacy).

Sources can take any shape or form and can refer to any component of the property and process perspectives. For instance, sources include the perceptions of safety properties that are "possessed" by a technology, the deliberate actions and strategies that stakeholders establish, such as information meetings (Binz et al., 2016), the inner beliefs that CE applications fit individuals' values, the societal validity (i.e., things that are held true in the society), and contextual events, such as an extended period of drought. By including sources that reflect static elements from legitimacy-as-property and strategies from legitimacy-as-process, which often interlink, this work provided a more comprehensive legitimacy picture of CE applications.

Table 7 – Elements adopted and adapted from the legitimacy-as-perception, legitimacy-as-property, and legitimacy-as-process perspectives in the perspective used in the thesis (Adapted from Suddaby, Bitektine, and Haack (2017)**)**

Source of perspectives	Legitimacy-as-perception	Legitimacy-as-property	Legitimacy-as-process
Elements of perspectives adopted from the literature	Legitimacy resides in the eyes of the beholder. Metaphor of property as taste (perceptions of property). Recognises the diversity in evaluators and their judgments at a microlevel.	Possessed properties in a binary manner (legitimacy categories).	Legitimation process (actions and strategies of actors). Artificial division between actors and the audience (neglects the nuanced and critical role of perceptions).
Additional elements of perspectives adapted from the literature to fit the thesis' aim.	Recognises the diversity of evaluators and aggregates individuals' perceptions.	Nuanced perceptions of possessed properties (legitimacy categories).	Diverse perceptions of actions and strategies.

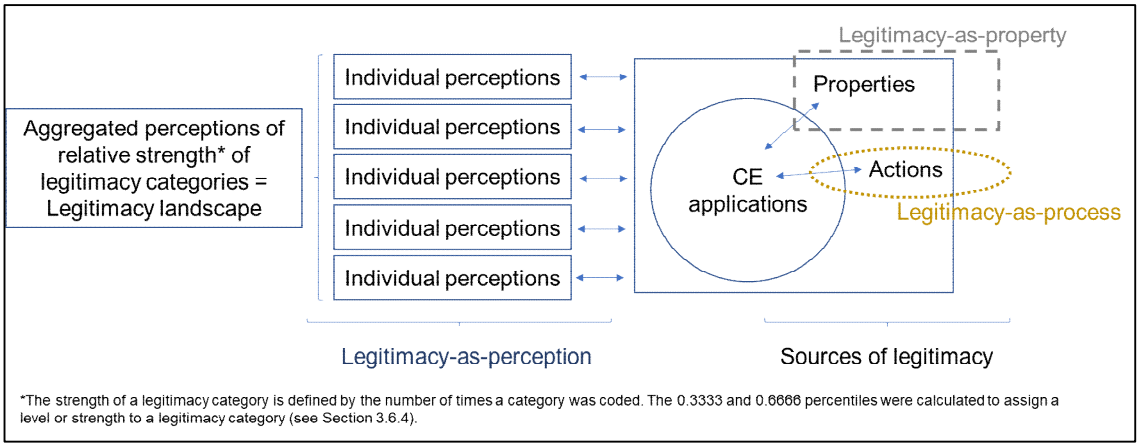


Figure 4 – Graphical representation of the legitimacy-as-perception, legitimacy-as-property, and legitimacy-as-process perspectives used in the thesis (Adapted from Suddaby, Bitektine, and Haack (2017)**)**

2.4.4 Reflection on legitimacy frameworks

The three perspectives detailed in Section 2.4.3 can adopt many legitimacy frameworks that a sociological approach offers (Figure 3, Table 4, and Table 8). Aldrich and Fiol's (1994) framework (Framework 1) differentiated socio-political from cognitive legitimacy (1994). Socio-political legitimacy was later split into normative and regulative legitimacy (Deephouse & Suchman, 2008), which gave rise to the two widely used frameworks of Suchman (1995) (Framework 2), including moral, pragmatic and cognitive legitimacy, and of Scott (1995) (Framework 3), including normative, cognitive and regulative legitimacy. The definitions of the five legitimacy categories are presented in Table 8. Table 8 only includes Frameworks 1, 2, 3 because it discusses the foundations of legitimacy in the organisation literature. Framework 4 will be discussed in Section 0. Framework 2 offered additional details for three legitimacy categories (moral, cognitive, and pragmatic) with nine sub-categories. The definitions of the sub-categories are detailed in the second and third columns of Table 9. Whilst moral legitimacy was divided into consequential, procedural, structural, and personal legitimacy, cognitive legitimacy differentiated comprehensibility and taken-for-granted legitimacy, and pragmatic legitimacy was divided in exchange, influence, and dispositional legitimacy. It is noted that moral and normative legitimacy are used interchangeably in the literature. 'Moral' legitimacy is the terminology used in the thesis to deliver empirical insights. 'Normative' legitimacy may be referred to in the discussion when comparing the thesis' empirical results with the literature that used the terminology 'normative'. 'Regulatory' legitimacy is the terminology used in the thesis throughout the results and discussion sections to refer to 'regulative' legitimacy of Suchman (1995), Scott (1995) and Binz et al. (2016).

Whilst cognitive and moral (normative) legitimacy categories were relatively similar across Frameworks 2 and 3, the two frameworks differentiated as they added a pragmatic and regulative dimension.

Table 8 – Comparison of five legitimacy categories from the legitimacy rameworks one, two, and three (Source: Aldrich and Fiol (1994)**, Suchman** (1995) **and Scott** (1995)**)**

Legitimacy category	**Framework 1** (Aldrich & Fiol, 1994)	**Framework 2** (Suchman, 1995)	**Framework 3** (Scott, 1995)
Moral and Normative		Prosocial evaluation of an organisation and its activities as the "right thing to do".	Normative rules establish obligatory and evaluative aspects in the society. Judgment based on values (preferred goal) and norms (how things should be done).
Cognitive	Spread of knowledge about a new venture until it becomes familiar and taken-for-granted.	Passive support based on cognition. Whether one affirmatively backs or perceives an organisation as necessary or inevitable.	Shared conception of social reality and frames through which meaning is made. Support occurs because alternatives are inconceivable, and routines are observed because they are the 'ways things are done'.
Pragmatic		Self-interested calculations of the audience about the benefits provided by an organisation.	
Regulative			Based on whether an organisation acts in accordance with relevant laws and regulations.
Socio-political	Judgment of a new organisation as appropriate and right given prevalent norms and laws.		

Cells in grey indicate that the corresponding legitimacy category was not included in a given framework.

In studies assessing the legitimacy of environmental technologies, Frameworks 2 and 3 were predominantly used independently from one another, leaving a pragmatic or regulatory gap in the evaluation of legitimacy (Table 8). In some studies, regulative legitimacy was not explicitly separated from moral legitimacy, and the relevance to distinguishing all four categories, that are moral or normative, cognitive, pragmatic, and regulative legitimacy, has been argued (Harris-Lovett et al., 2015). This argument gave rise to the combination of Frameworks 2 and 3 to study the legitimation of water reuse in California (Binz et al., 2016), wind power technologies in Germany (Dehler-Holland et al., 2022), and genetically modified food in the Netherlands (Jansma et al., 2019). Combining the two frameworks has the potential to provide a more fine-grained understanding of the legitimacy of CE applications, which includes pragmatic and regulatory aspects. This study, therefore, combined Frameworks 2 and 3 into Framework 4, including moral, cognitive, pragmatic, and regulatory legitimacy.

2.4.5 Reflections on legitimacy categories: legitimacy typology of the thesis

The thesis adopted the framework combining moral, cognitive, pragmatic, and regulatory legitimacy presented at the end of this section in Table 9 for many reasons. First, the four legitimacy categories have been used to understand the legitimacy of various environmental technologies, including CE applications in the water sector (Harris-Lovett et al., 2015). Second, the four legitimacy categories are highly relevant to study the legitimacy of CE applications. The relevance of the four categories is detailed in the following sentences. Social norms play a significant role in defining what is approved within societal groups (Fielding et al., 2019) as one is likely to accept water reuse if others already use recycled water (Chen 2013), which refers to moral legitimacy. The social validity for resource recovery, such as nutrients and energy recovery from wastewater, is partly based on cultural practices (Wells et al., 2016), which refers to cognitive legitimacy. Perceptions of benefits brought by CE applications such as water reuse have an impact on the overall perceptions of these applications (Michetti et al., 2019),

which refers to pragmatic legitimacy. Risk-based regulations ensured health, safety, and transparency, and lead to public support and a wide adoption of water reuse in Australia and the US (Mukherjee & Jensen, 2020), which refers to regulatory legitimacy.

2.4.6 Moral Legitimacy

Moral legitimacy reflects the active judgment of whether an organisation fits social values and norms in a manner that enhances societal welfare; the CE applications are the "right thing to do" (Suchman, 1995, p. 579). Its first constituent, consequential legitimacy, is based on socially valued consequences or the accomplishment of CE applications (Suchman 1995; Harris 2015). Studies looking at legitimacy of water reuse adopt an instrumental and narrower definition of consequential legitimacy with, for instance, a strong history of providing safe reused water (Harris-Lovett et al., 2015). It has been argued that professional and instrumental aspects are effective in signalling legitimacy to the general public (Harris-Lovett et al., 2015). However, the present study looks at contemporary cases of CE applications from an early stage that had not yet proven long-term results. The public and less involved stakeholders are more likely to be aware of broader societal and environmental impacts. Moreover, studies looking at legitimacy of environmental technologies identified environmental and societal impacts (Dehler-Holland, Okoh, and Keles 2022; Rohe and Chlebna 2021). Therefore, consequential legitimacy looks at outcomes and goals associated with CE applications that are defined by a normative system as socially valuable (Scott, 1995; Suchman, 1995). Mor specifically, this work looks at perceptions that CE applications and the implementing organisation pursue goals that will help deal with future societal challenges. Since environmental technologies such as CE applications have the potential to offer many societal benefits in addition to water benefits, the consequential dimension is broader than the water system.

Its second sub-category, structural legitimacy is based on the constructed capacity to perform a particular type of work that locates organisations and CE

applications as ‘right for the job’ (Suchman, 1995, p. 579). Studies looking at legitimacy of environmental technologies rely on an instrumental definition which refers to the physical characteristics of CE applications that enhance its safety (e.g., state-of-the-art water quality lab) or informal design rules and principles of what a ‘good technology’ is (Dehler-Holland et al., 2022; Markard et al., 2016). Moreover, the constructed capacity of CE applications also refers to professional attributes such as normative networks of independent expert that provide a certification (Binz et al., 2016). This study refers to the structural capacity of CE applications based on physical characteristics to generate safe outputs, and embedding networks.

Its third constituent, procedural legitimacy, refers to socially accepted procedures and techniques (Scott, 1995; Suchman, 1995). As illustrated in a study looking at the legitimacy of water reuse (Harris-Lovett et al., 2015), moral procedural legitimacy reflected the adoption of strict quality control and professional training to ensure safety. Its final component, personal legitimacy, rests on perceptions that representatives and leaders demonstrate integrity and trustworthiness (Suchman, 1995), as managers who are perceived as trustworthy and competent help the broader legitimacy of novel technologies such as water reuse (Harris-Lovett et al., 2015). Examples of actions that foster personal legitimacy include water utility managers being involved in outreach work (Harris-Lovett et al., 2015).

2.4.7 Cognitive Legitimacy

Cognitive legitimacy is a passive assumption that an organisation or a technology is comprehensible and taken-for-granted (Suchman, 1995). Its first constituent, comprehensibility, relates to perceptions that CE applications mesh with people’s daily life routines and pre-existing cultural beliefs (Scott, 1995; Suchman, 1995). Moreover, studies looking at the legitimacy of organisations and environmental technologies consider the understanding and knowledge of a technology and its purpose (Aldrich & Fiol, 1994; Dehler-Holland et al., 2022; Markard et al., 2016; Suchman, 1995). Therefore, the understanding, knowledge and awareness of CE

applications were also included in the definition of cognitive comprehensibility legitimacy for this research.

Its second constituent, taken-for-grantedness, describes CE applications as inevitable, necessary, and not consciously questioned (Harris-Lovett et al., 2015; Suchman, 1995); CE applications become part of a broader cognitive coherence and integrative change (Suchman, 1995). This sub-category is hard to measure because asking stakeholders about an entity – CE application – is in itself a way of questioning it (Deephouse & Suchman, 2008), which may partly explain why environmental technologies studies capture it less often than comprehensibility legitimacy. Moreover, it is argued that taken-for-granted legitimacy is hard to reach in the early stages of the development of a technology or an organisation because it is the most self-sustaining and profound category of legitimacy (Jaber & Oftedal, 2020; Suchman, 1995). Therefore, studies looking at legitimacy of environmental technologies tend to focus on knowledge and understanding aspects only (Jansma et al., 2018). However, there are perceptions that can indicate taken-for-grantedness. Such perceptions include the association of CE applications, such as water reuse, with taken-for-granted practices such as domestic waste recycling (Harris-Lovett et al., 2015). Moreover, the prevalence of CE applications is a good indication of cognitive legitimacy (Hannan & Freeman, 1984). It is not claimed, however that the identification of taken-for-granted perceptions means that CE applications have reached the highest level of cognitive legitimacy. It rather gives early indications that CE applications may become taken-for-granted.

2.4.8 Pragmatic Legitimacy

Pragmatic legitimacy is based on self-interested calculations about the benefits that CE applications bring to their end-users (Harris-Lovett et al., 2015; Suchman, 1995). Its first constituent, exchange legitimacy, is based on the service or good provided to end-users by CE applications. Whilst environmental technologies studies mainly refer to economic and financial benefits (Biloslavo et al., 2020; Dehler-Holland et al., 2022; Rohe & Chlebna, 2021), CE applications are likely to

benefit various stakeholders differently (Salminen et al., 2021). Exchange legitimacy in this thesis refers to any benefit or disadvantage, and value perceived by various stakeholders (Suchman, 1995), and the actions that can increase the perceived visibility of benefits, such as education and outreach strategies (Harris-Lovett et al., 2015).

Its second constituent, influence legitimacy, arises when stakeholders perceive that they are incorporated into decision- and policy-making processes for the CE applications (Suchman, 1995). References to involvement in the environmental technology literature, although scarce, include focus groups, surveys, and user representatives in decision-making bodies (Harris-Lovett et al., 2015). This work looks at the perceptions of all stakeholders about the possibility they are given to influence and participate in the decision process for the development of CE applications.

The last constituent, dispositional legitimacy, appears if CE applications are managed by an organisation that shares end-users' and stakeholders' values and is perceived as a good character, honest and trustworthy (Suchman, 1995). In the environmental technologies studies, dispositional legitimacy includes, for instance, the provision of transparent information and policies, as well as the assessment of the reputation, and the reputational benefits for the adopting companies (Biloslavo et al., 2020; Harris-Lovett et al., 2015). In the organisational and environmental technologies literatures, the dispositional dimension usually refers to the personification of an organisation (Suchman, 1995) and particularly of the companies adopting CE applications (Harris-Lovett et al., 2015). This work hypothesises that CE applications can also be personified. Thus, this framework includes perceptions that CE applications and the adopting company are aligned with stakeholders' values.

2.4.9 Regulatory Legitimacy

Finally, regulatory legitimacy is defined as the capacity to set up rules and assess others' congruence to them, and concerns the laws and regulations associated with an activity (Scott, 1995). When associated with normative legitimacy within

the same framework, regulatory legitimacy tends to include elements from moral structural and procedural legitimacy (e.g., protocols, standards, procedures, technology characteristics) (Markard et al., 2016; Scott, 1995) and regulatory legitimacy is not explicitly separated (Harris-Lovett et al., 2015). Whilst procedures and structures ultimately derive from regulations, normative (moral) and regulatory legitimacy differ in that normative legitimacy is based on norms and the moral obligation, and regulatory legitimacy on laws and regulations and compliance mechanisms (Bitektine, 2011). This thesis draws the line between moral (normative) and regulatory legitimacy and includes monitoring and design characteristics in moral (normative) legitimacy, whilst regulatory legitimacy is concerned with laws, regulations and the government's role in the development of CE applications.

Table 9 – Definitions of four legitimacy categories in the context of organisations and water reuse studies, and presentation of the thesis typology (Adapted from Scott (1995)**, Suchman** (1995)**, Harris-Lovett et al.** (2015) **and Binz et al.** (2016)**)**

Legitimacy sub-category	**Organisation** (Scott, 1995; Suchman, 1995)	**Example in the water reuse literature** (Binz et al., 2016; Harris-Lovett et al., 2015)	**Thesis typology**
Moral Consequential	Based on the organisation's accomplishments.	Strong record of providing quality reused water.	Perceptions that CE applications accomplishments and pursued goals benefit the society and the environment.
Moral Structural	Based on the organisation's socially constructed ability to perform a given 'job'.	Physical characteristics of water reuse systems, and state-of-the-art labs and technologies.	Perceptions about the physical characteristics of CE applications, and the constructed capacity of the network associated with them.
Moral Procedural	Based on socially valued techniques and procedures.	Testing and monitoring procedures.	Perceptions that CE applications are implemented and managed using appropriate procedures.
Moral Personal	Based on the charisma of the organisation's leader.	Managers engagement in outreach campaigns.	Perceptions about the charisma, and trustworthiness of CE applications leaders.
Cognitive Comprehensibility	Based on the provision of coherent cultural models that mesh with larger belief systems, and the audience's daily life.	Comprehensible framing of water reuse.	Perceptions of CE applications as known, understood, plausible, meshing with stakeholders' daily life routines and pre-existing cultural beliefs.

Legitimacy sub-category	**Organisation** (Scott, 1995; Suchman, 1995)	**Example in the water reuse literature** (Binz et al., 2016; Harris-Lovett et al., 2015)	**Thesis typology**
Cognitive Taken-for-granted	Based on the organisation being perceived as a 'given' where alternatives are unthinkable.	Relating water reuse to taken-for-granted frames such as recycling, and a lack of opposition.	Perceptions of CE applications as associated with taken-for-granted frames, inevitable, and not consciously questioned.
Pragmatic Exchange	Based on the value that an organisation provides to its audience.	Outreach campaigns to explain the benefits of water reuse.	Perceptions related to outreach strategies, and benefits provided by CE applications to stakeholders.
Pragmatic Influence	Based on the incorporation of the audience in decision-making processes.	Shared decision-making with end users through surveys, focus groups and citizens' representatives.	Perceptions to be included in the decision-making processes for CE applications.
Pragmatic Dispositional	Based on the trustworthiness and the good character of organisations.	Transparent policy information, cooperation with external evaluators, quality brand, and sector's good character.	Perceptions CE applications and the adopting company are aligned with stakeholders' values and trustworthy.
Regulatory	Congruence with laws and regulations.	Water reuse technologies operate in line with regulations.	Perceptions that CE applications are aligned with laws and regulations.

2.5 Concluding remarks

The literature review was set out to answer three questions: (1) “How does a legitimacy perspective provide a complementary view to an acceptance perspective?” and (2) “What legitimacy perspective and framework are the most appropriate to understand perceptions of CE applications?”, and (3) “How has legitimacy been applied in environmental technologies studies?”. Perceptions of CE applications have extensively been explored using an acceptance perspective in many contexts and among various actors, whilst the application of Legitimacy Theory has been limited in the CE literature. The literature review showed that a legitimacy perspective has the potential to provide a complementary view for the understanding of perceptions towards CE applications by (1) embedding CE applications within their institutional contexts, (2) connecting them with a large range of stakeholders, (3) and providing a comprehensive range of perceptions with nuanced levels. Moreover, the review showed that a sociological approach that is perceptual would serve the purpose of the study better than a normative perspective that aims to match a pre-defined set of criteria. The legitimacy literature on organisations and environmental technologies revealed the usefulness of combining three legitimacy perspectives (legitimacy-as-property, legitimacy-as-process, and legitimacy-as-perception) to look at perceptions of properties and actions associated with CE applications. Moreover, it showed that adopting a framework of four legitimacy categories, namely, moral, cognitive, pragmatic, and regulatory, can assist in capturing a comprehensive range of perceptions. Finally, it showed that legitimacy of environmental technologies has mainly been studied in the energy sector using historical analyses.

Therefore, the knowledge gaps that this study aims to fill are (1) a lack of in-depth and nuanced understanding of societal-based and cultural-based factors in the CE literature, (2) a limited understanding of whether CE applications can be perceived as legitimate, and more specifically (3) of whether contemporary cases of water-centric CE applications can be perceived as legitimate or if legitimacy

can only be acknowledged in retrospect in historical studies, and (4) a limited understanding of whether legitimacy perceptions apply beyond individual CE applications to a combination of water reuse, nutrients and energy recovery among a wide range of stakeholders.

3 METHODOLOGY

3.1 Ontological and epistemological approaches

The aim and objectives as defined in Section 1.7, determined the ontological and epistemological approach of the thesis. Whilst the ontology is concerned with what is possible to know about reality, the epistemology refers to how it is possible to generate knowledge about it (Ritchie et al., 2013). The aim of the thesis was to look at the perceptions of CE applications by stating that legitimacy first exists because it resides “in the eyes of the beholder”, following a legitimacy-as-perception approach introduced in Section 2.4.2 (Ashforth & Gibbs, 1990, p. 177). Hence, idealism or the view that reality is known through the human mind and is socially constructed, was the ontological approach chosen for this research. Moreover, this thesis argued for a more comprehensive understanding of perceptions of CE applications. Whilst the research mainly applied a legitimacy framework with four defined categories, which relates to a deductive logic, an inductive logic was also used to expand on the existing knowledge on legitimacy. Therefore, a hybrid positivist-interpretivist epistemological approach was taken.

3.2 Case study method

A case study method was employed for three main reasons: the exploratory nature of the study, the opportunities to look at contemporary cases of CE applications to generate empirical insights, and the focus on the aggregation of perceptions from a variety of stakeholders. First, this work is exploratory in that it looks at what aspects of legitimacy are utilised in stakeholders’ perceptions of CE applications, and how these aspects interact, as well as how the interaction with local case studies of CE applications influences the perceptions of other CE applications and how legitimation processes can be advanced. A case study method is particularly suited to address the exploratory “how” question (Yin, 2014), i.e., how are CE applications perceived with regard to the four legitimacy categories, especially given that legitimacy perceptions have not been studied in the context of multiple CE applications in the water sector.

Second, the literature review revealed that studies using a legitimacy framework to look at environmental technologies mainly employed historical analyses. There are opportunities to explore the legitimacy perceptions towards contemporary cases of CE applications to generate empirical insights. It was also argued that CE applications interact and are embedded in their contexts, and particularly in their institutional contexts, meaning that the context is essential to the understanding of the case study. As opposed to a historical method, a case study method, which is an “empirical inquiry”, is adapted to examine contemporary events within their real-world context (Yin, 2014, p. 16).

Third, the legitimacy perspective adopted in this work relies on an infinite set of perceptions of stakeholders towards CE applications aggregated at a collective level. A case study method usually relies on multiple sources of evidence, i.e., multiple stakeholders in this study, and allows data to converge in a triangulation style (Yin, 2014).

3.2.1 Multi-case studies

In the literature looking at the legitimacy of environmental technologies, there has been an emphasis on longitudinal single cases. Although they are essential to explore how legitimacy and legitimation form and change over time, the study of contemporary events may benefit from multi-case studies. A multi-case design was employed because it prevented from the uniqueness of single case study studies (Yin, 2014). Following a multiple-case design, this research comprised the in-depth and independent analysis of three case studies (Yin, 2014). The individual results from each of the cases were later combined and synthesised in the results and discussion sections. This approach is detailed in Figure 5.

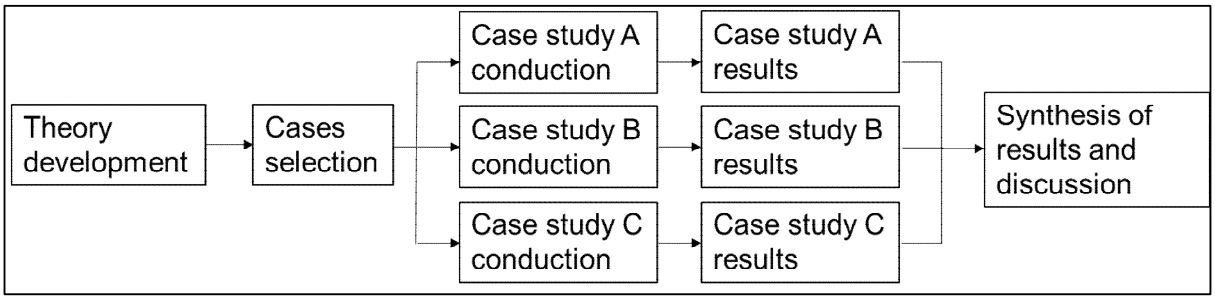


Figure 5 – Approach taken to conduct a multi-case studies design in the thesis (Adapted from Yin, 2014)

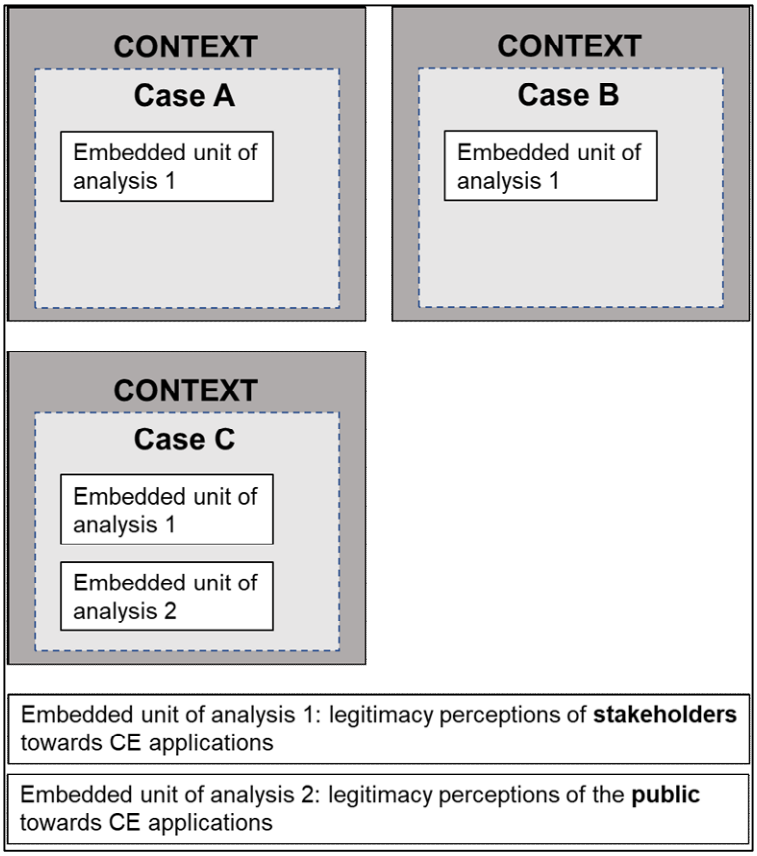


Figure 6 – Embedded units of analysis used as part of the case study design for the thesis (Adapted from Yin, 2014)

The boundaries of each case study were defined as follows. Each case study comprised of one or more CE applications, the associated stakeholders and organisations, members of the public for Case C only, and the institutional

context. An embedded design was chosen to satisfy two units of analysis that delineated two types of interviewees: stakeholders who directly interacted with the CE applications of each case study, and members of the public (Figure 6). The first unit of analysis included stakeholders' perceptions of sources associated with four legitimacy categories with regard to case studies' CE applications (Chapter 4). The second unit of analysis included public perceptions of sources associated with four legitimacy categories with regards to a hypothetical case study of CE applications (Chapter 5). The hypothetical case was inspired by Case C, which was provided by the project funding this research. Members of the public were not aware of the association between the hypothetical case and Case C to ensure the anonymity of the case. The second unit of analysis was studied in case C only for data accessibility reasons.

3.2.2 European context and selection of case studies'

This research was funded through two four-year European Projects (NextGen and ULTIMATE), which were financed by the European Union Horizon 2020 research and innovation programme under grant agreements 776541 and 869318, respectively. The two projects had similar aims. Whilst the NextGen project aimed to evaluate CE applications that challenge current practices and thinking in the water sector, the ULTIMATE project aimed to act as a catalyst for Water Smart Industrial Symbiosis, i.e., a group of organisations that exchange resources derived from wastewater. Cases of organisations trialling CE applications (water reuse, nutrients and energy recovery) in industrial, agricultural, and municipal settings for the NextGen project and industrial settings for the ULTIMATE project were demonstrated. This research was part of two respective work packages that aimed to address social, governance, and regulatory challenges and opportunities to the uptake of CE applications. The two projects gave access to a wide range of contemporary case studies that trial CE applications in Europe (i.e., water reuse, nutrients and energy recovery).

The European context is particularly relevant to the study of perceptions of the CE in that the European Union has been a pioneer in implementing CE

applications, guided by ambitious policies (Mhatre et al., 2021). The European Commission adopted a new CE Action Plan in March 2020, which is part of the European Green Deal (European Commission, 2022a). The CE Action Plan facilitated the implementation of the CE in the EU region (Mhatre et al., 2021). Moreover, a regulation on minimum water quality requirements for water reuse in an agricultural context was enforced in June 2020 (European Commission, 2022b). In this respect, an increase in sustainable practices is expected in the wastewater context (Smol et al., 2020). Given that CE applications in the EU have mainly been about recycling (Mhatre et al., 2021), there are opportunities to understand legitimacy perceptions towards reuse and recovery applications to speed up their development.

In a multiple-case research design, Yin (2014) states that each case may be selected to either predict similar results or contrasting ones for expected reasons. This study followed the latter and expected different results for contextual reasons. This study employed a multiple-case study design but took a variety of case studies that share a common characteristic – the implementation of CE applications – and differ in many aspects, which may induce different results. Therefore, to illustrate the legitimacy framework established in Section 0, three European case studies were selected to reflect a wide range of countries (The UK, Sweden, and The Netherlands), technologies (water reuse and nutrients and energy recovery), settings (i.e., municipal and industrial), and institutional contexts.

Moreover, the cases were selected on the basis that they engaged in stakeholders' outreach and involvement strategies, which ensured that social perceptions could be evidenced. Finally, the case studies were chosen as they ensured accessibility to data (Crowe et al., 2011). A description of the selected case studies is presented in Figure 7and Table 10. A fourth case (Case D) was used to perform interviews with stakeholders and members of the public but was not included in the thesis because the quality of the data was poor, and some consent forms were not returned. Case D was located in Italy and implemented

water reuse and nutrients recovery as part of an industrial symbiosis in the chemical industry.

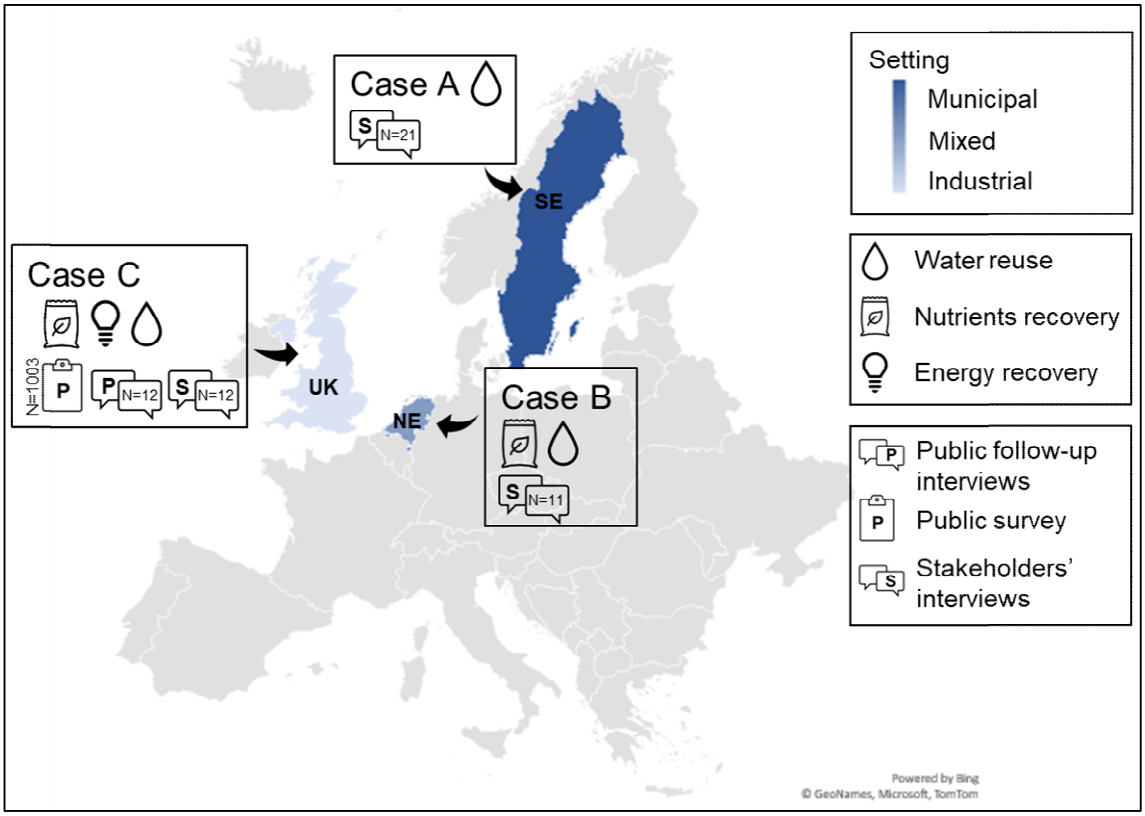


Figure 7 – Summary of the setting, type of CE applications, sample and method used for the three case studies

Table 10 – Description of the country, context, and type of CE applications for the three case studies

Case	Country	Context	Circular technology
A	Sweden	Municipal	Water reuse*, rainwater harvesting
B	The Netherlands	Mixed municipal and industrial (brewery)	Water reuse and nutrients recovery
C**	UK	Industrial symbiosis (distillery)	Water reuse, nutrients and energy recovery

*Water reuse in Case A is part of a 'testbed', also including rainwater harvesting. The testbed was part of a wider water and waste management plan, including desalination.

**Case C had already implemented CE applications before implementing the applications under study.

3.3 Qualitative research: interviews

Since this research aims to scrutinise legitimacy perceptions towards CE applications, a qualitative approach was used as it addresses questions that need understanding and explanation about a social phenomenon in its context (Ritchie et al., 2013). Qualitative approach such as interviews are one of the most important sources for case studies (Yin, 2014). An interview method was chosen as it focuses the discussion on the case topic (Yin, 2014), provides an in-depth understanding of interviewees' experience and perceptions, and is suited for the understanding of complex processes and systems (Ritchie et al., 2013), such as the system of interactions between legitimacy and CE applications at play in this study.

3.4 Selection of interviewees: case studies' stakeholders

For each case study, a list of potential stakeholders was created based on available resources about the case studies, including the lists of participants in local communities of practice, and on recommendations from the literature. Scholars in the literature looking at the legitimacy of water reuse interviewed diverse stakeholders, including those associated with research institutes, universities, governments (e.g., policy officers and local authorities such as water boards), engineering consulting companies (i.e., technology providers), water and sewage service providers, and advocacy organisations (Binz et al., 2016; Harris-Lovett et al., 2015). Other studies looking at the legitimacy of environmental technologies have shown the importance of interviewing members of the local community, including community representatives and members of local associations, societies, and charities (Genus and Iskandarova 2020). The local community can also include stakeholders from the agricultural sector, like landowners and farmers (Nölting & Mann, 2018; Webb et al., 2009). The stakeholders were classified according to eight categories: governance, service and product providers, technical stakeholders, local community, agriculture, communication, research and education, and not-for-profit organisations (Table 11). When one stakeholder belonged to more than one category, it was assigned

to the role and category that were the most relevant in the context of the case study.

Using an analytical categorisation method, in which the classification is performed by those conducting the research according to their observation of the phenomenon, a power-interest matrix was created for each case study to categorise and prioritise the identified stakeholders (Ambrosini et al., 1998; Johnson et al., 2008; Mendelow, 1981). The power-interest matrix methodology was chosen because it allows to think through stakeholders' impacts on the development of the entity of interest (Johnson et al., 2008). In other words, stakeholders' perceptions of how CE applications are legitimate will impact their development differently depending on how much interest and power stakeholders hold. The interest is the extent to which stakeholders are likely to demonstrate interest in opposing or supporting a particular strategy (Johnson et al., 2008). Power is the capacity of stakeholders to persuade others to take a certain route (Johnson et al., 2008). Indicators of power can include status, representation in powerful positions and power symbols, and access to resources (Johnson et al., 2008). The power interest matrix contains four categories (Figure 8): context setters, players, crowd, and subjects (Reed et al., 2009). Key players were first prioritised for interviews, followed by stakeholders in the three other quadrants.

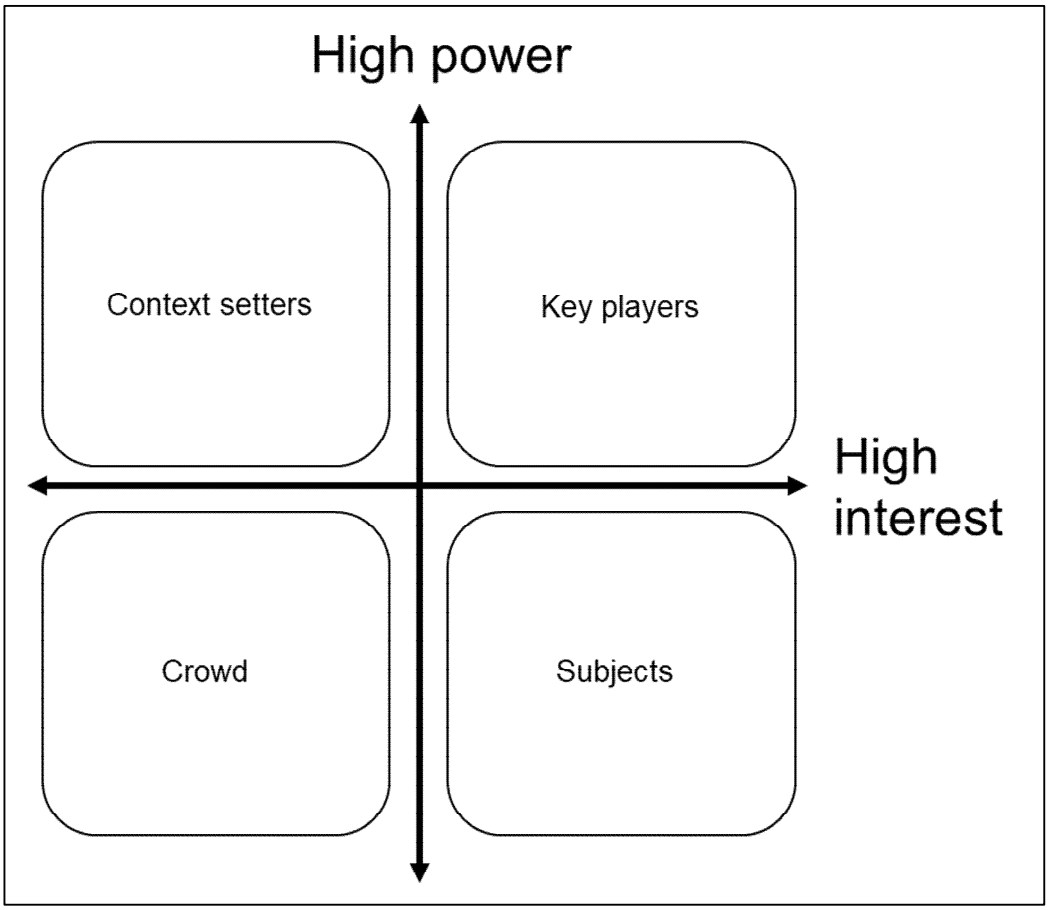


Figure 8 – The four categories of stakeholders in a power-interest matrix (Reed et al., 2009)

Scoping interviews were then conducted with the leaders of each case study to validate and complement the initial list and power-interest matrix (Figure 9). Snowballing was then used to identify the remaining stakeholders. Finally, the lists and matrices were refined by the researcher based on the information gathered in the interviews. The selected study participants reflect a spectrum of stakeholders that includes various levels of power, knowledge, interest, and involvement with the case studies (from highly engaged to unaware of the case study). The list of stakeholders interviewed is shown in Table 11. The power-interest matrices for Cases A, B, and C are shown in Figure 10 and Figure 11.

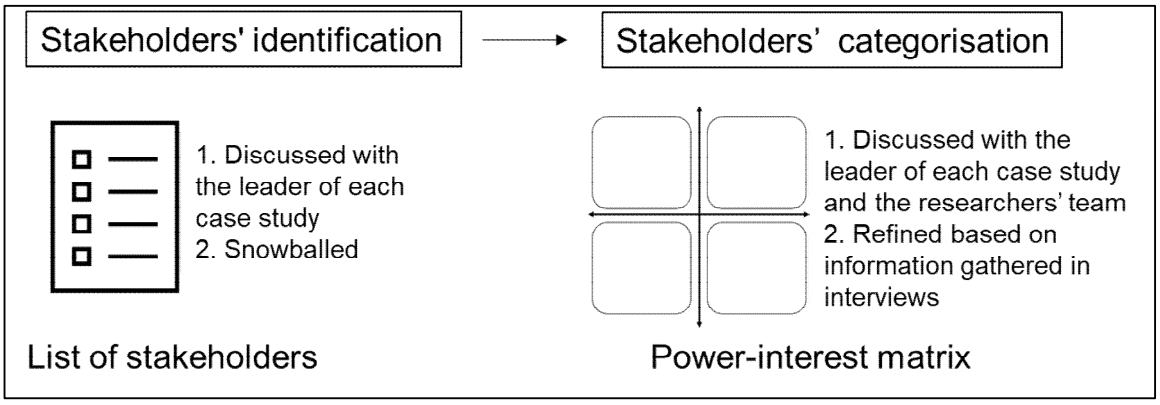


Figure 9 – Process of stakeholders' identification and categorisation in the thesis

Table 11 – Description of type and number of stakeholders interviewed in Cases A, B, and C

Organisation	Stakeholder	A	B	C
Governance	Environmental regulators, deputy director in the government, water specialist in the municipality (local government), member of the parliament, industry advisor at a water board, advisor at an intergovernmental agency, policy officers in waste and water topics.	2	4	3
Service and product providers	Sustainability officer of a maltster company, business manager at a sludge recycling company, business developer in a water and wastewater asset management company, asset planner at an operating company, director of a chemical company, and engineer and plant manager at water utilities.	0	0	4
Technical stakeholders	Directors, CTOs, CEOs, founder, R&D and operations manager, general manager, CE specialists, engineers at a technology provider company. Geologist from a data provider organisation.	3	7	1
Local community	Local businesses members, local inhabitant.	4	0	0
Agriculture	Farmers and landowners.	2	0	1

Organisation	Stakeholder	A	B	C
Communication	Journalist, author, communication, and information officers in a water board.	4	0	0
Research and education	Researchers, students, and case leader.	4	0	0
Non (and not) for-profit organisations	Founders of a local association, Marine Conservation lead, sustainability lead of a trade organisation, engagement officer of a waste NGO.	**2	0	3
All		21	11	12

** Not recorded; notes taken for one interview. CEO abbreviates Chief Executive Officer, CTO abbreviates Chief Technology Officer, NGO abbreviates Non-Governmental Organisation, and R&D abbreviates Research and Development. A, B, and C correspondent to Cases A, B, and C.

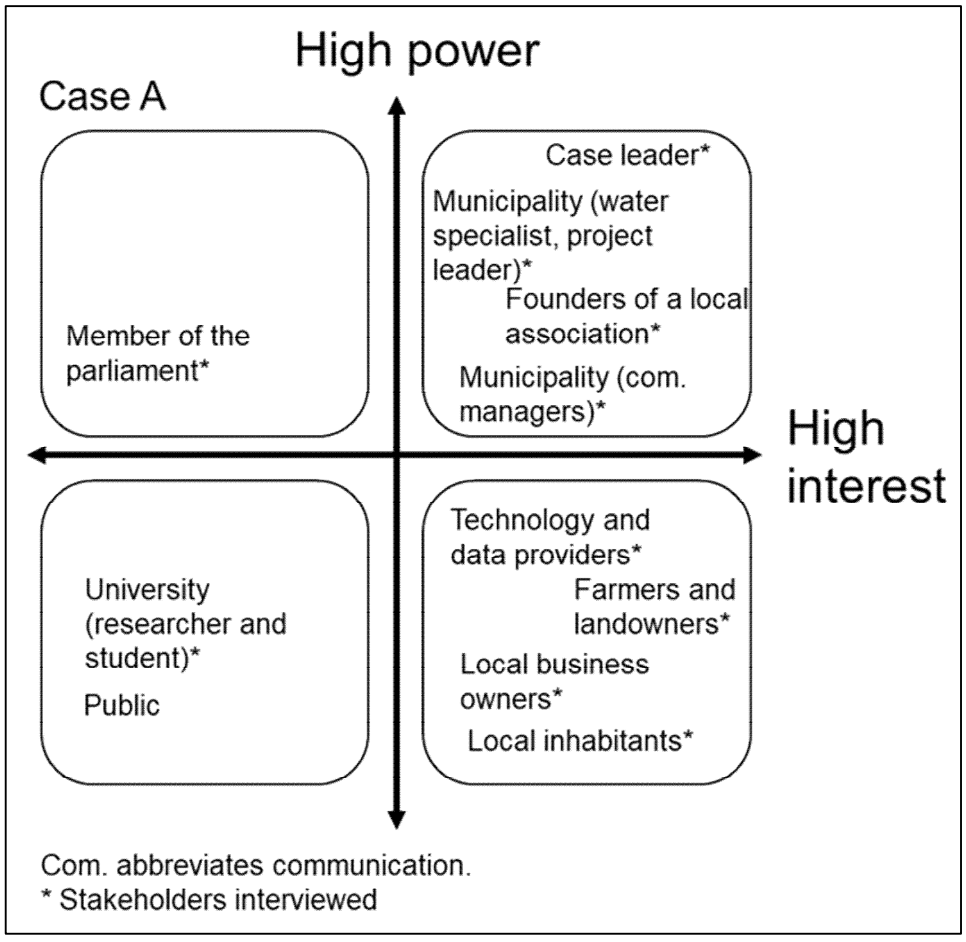


Figure 10 – Power-interest matrices for Case A

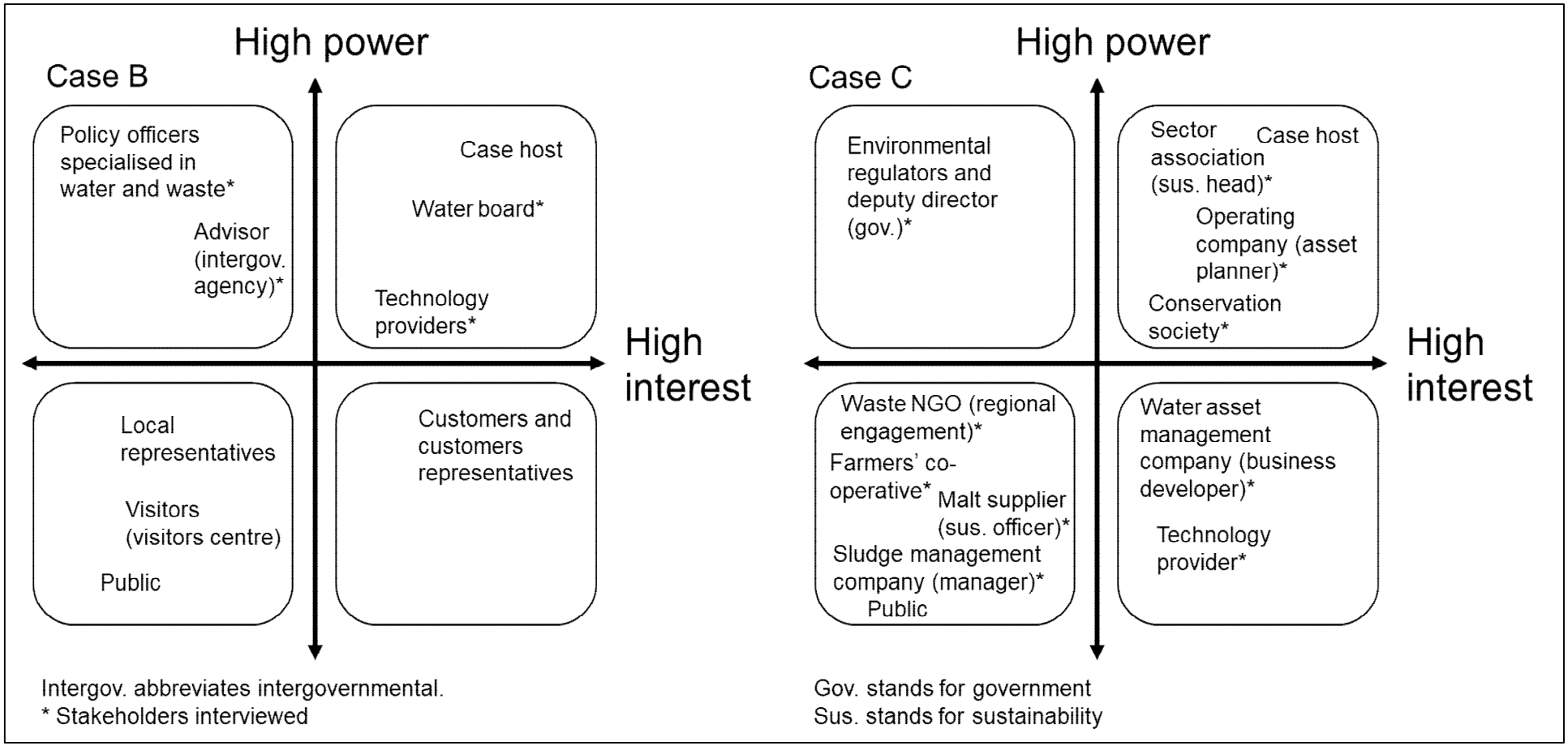


Figure 11 – Power-interest matrices for Cases B and C

3.5 Selection of interviewees: members of the public

A survey was conducted as part of the Ultimate project, after which interviewees were given the option to take part in a follow-up interview by providing their email addresses. The survey was carried out in the UK in January 2021 (n = 1003). The Qualtrics survey tool was used to conduct the survey and quotas were applied to control for the following demographics: age, gender, administrative region, highest level of education, employment status, and whether interviewees had children. The survey collected responses on general awareness of the CE, expectations for social and environmental responsibility, preferences for governance, values perspectives, and legitimacy. The survey data sat outside the scope of the thesis and was used as a mechanism to recruit interviewees. The participation to follow-up interviews was voluntary, and a gift voucher was offered to one randomly selected interviewee. The demographics of the sample are presented in Table 12. A purposive sampling strategy was used to select interviewees among those who provided their email addresses for a follow-up interview to reflect varied demographics (Daniel, 2014; Palinkas et al., 2015).

Table 12 – Demographics of the public sample for Case C, including the age, region, gender, occupation, education, and family situation

Variable	Category	C	Variable	Category	C
Age	18-24	0	**Gender**	Male	7
	25-34	1		Female	5
	35-49	2	**Occupation**	Full-time employed	4
	50-64	5		Part-time employed	0
	65+	4		Self-employed	1
Region	East	1		Unemployed	0
	East Midlands	1		Student	0
	Greater London	2		Retired	6
	North East	1		Unable to work	1
	North West	2		Prefer not to say	0
	Scotland	1		University +	10

Variable	Category	C	Variable	Category	C
Region	South East	1	**Education**	A-levels	1
	South West	1		Upper sec. educ.	0
	Wales	1		GCSE\O-Level	1
	West Midlands	1	**Children**	Yes	8
				No	4

3.6 Data collection and analysis

3.6.1 Topic guides for stakeholders' interviews

A semi-structured interview topic guide was developed to interview stakeholders. A summary of the topic guide is presented in Table 13 and the full guides can be found in Appendices A.1.1 and A.1.2. The topic guide included questions associated with the four legitimacy categories. Most of the questions could trigger different legitimacy categories. However, when a section was targeted at a particular legitimacy category, it was annotated in Table 13. An opening question explored interviewees' perceptions of the CE concept for Case C only. The first set of questions covered the interviewee's position and role in their organisation, the economic, environmental, social, and regulatory contexts of the case study, the interviewee's organisation role (if any) in the development of the case, the network of stakeholders and their motivations in taking part in the case. The second set of questions related to the compliance and challenges with regard to regulations, laws and policies. The third set of questions investigated the interviewee's perceptions about (1) the aim, impacts, benefits, and concerns regarding the case at a local and global level and (2) the soundness of the case and its relation to the daily lives of a variety of stakeholders, i.e., local communities, public, policy makers, customers, farmers. The fourth set of questions explored interviewees' perceptions of other stakeholders' perceptions (i.e., local communities, public, policy makers, customers, and farmers) with regard to (1) outreach and involvement activities, including involvement in the decision-making, (2) the level of awareness about the case, (3) stakeholders' positive and negative perceptions of the case and its soundness, impacts at a

local and global level, benefits, and the relation to stakeholders' daily lives. Finally, the discussion was broadened to explore the interviewees' (1) general level of support for the case, (2) view on what is needed to increase support, and (3) view of the broader CE concept by introducing a definition of the CE. Recognising that the CE is a broad concept with many definitions, the following definition was provided to interviewees: "A CE is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems" (Ellen MacArthur Foundation, n.d.). Another section (sixth) was added when interviewing stakeholders of Case C to satisfy the requirement of the Ultimate project. This section included questions about the interviewee's perceptions of (1) their own and stakeholders' (e.g., customers) expectations of the case, (2) results accessibility and shared decision-making strategies, and (3) their organisation willingness to compromise and motivation to adopt CE applications. Finally, interviewees were given the opportunity to share any further information that was not discussed during the interviews.

Table 13 – Summary of the topic guide used for stakeholders' interviews

Section	Content of interview's section
Opening	- Opening question: perceptions of the CE concept (Case C only).
1	- Interviewee's position and role. - Context of the case. - Role of the interviewee's organisation in the case. - Network of stakeholders and motivations.[a]
2	- Compliance and challenges with regard to regulations.[d]
3	Interviewee's perceptions with regards to: - Aim, impacts, benefits, concerns at a local and global level.[a,c] - The soundness of the case and its relation to the daily lives of stakeholders.[b,c]
4	Interviewee's perceptions of other stakeholders' perceptions with regards to: - Outreach and involvement activities.[b,c] - Awareness level.[b]

Section	Content of interview's section
4	- Soundness, impacts at a local and global level, benefits, and relation to stakeholders' daily lives.[a,b,c]
5	Interviewee's perceptions with regard to: - General level of support for the case. - Elements needed to increase support. - CE definition.
6	Interviewee's perceptions with regard to (Case C only): - Interviewee's and stakeholders' expectations. - Decision making, input, and shared decision-making strategies.[a,c] - Willingness to compromise and motivations to adopt CE applications.

[a] Questions that prompt moral legitimacy. [b] Questions that prompt cognitive legitimacy. [c] Questions that prompt pragmatic legitimacy. [d] Questions that prompt regulatory legitimacy.

3.6.2 Topic guide for public interviews

A semi-structured topic guide was developed to interview members of the public. A summary of the topic guide is presented in Table 14 and the full guide can be found in Appendix A.2.1. Most of the questions could trigger different legitimacy categories. However, when a section was targeted at a particular legitimacy category, it was annotated in Table 14. A first set of questions asked to reflect on the survey they previously took using legitimacy prompts and, on the term "CE", general perceptions, advantages, and concerns about the general idea of the CE in the water sector**.** Second, a graphical representation of case C was designed to help members of the public understand the CE applications (Figure 12). The anonymity of the case was ensured by introducing the diagram as a hypothetical example of the implementation of CE applications at a brewery. Against the case diagram, the second set of questions explored general perceptions of the diagram as well as perceived concerns and advantages. Third, interviewees were asked questions related to a perceived hypothetical experience of the three components of the CE in the water sector: water reuse, nutrients and energy recovery. They were asked about how they would feel if they were to (1) visit a distillery powered by energy generated through sludge treatment, (2) drink beverage made of raw

material grown with recovered nutrients, and (3) produced by a company that recycles water. Fourth, interviewees were asked about their understandability of the diagram, perceived aim of the system, and benefits and costs to the society. Fifth, interviewees were asked to act as (1) consumers, (2) local citizens, and (3) members of the general public to detail their perceptions of the benefits to them, the society, and the environment, and concerns about the CE applications. Sixth prompts associated with the four legitimacy categories were used to trigger any aspect that may not have been covered in the interview. Seventh, the next set of questions assessed interviewees' perceptions of the adopting company. Finally, the last questions explored perceptions of what could be done to improve interviewees' judgments of such applications, and perceptions of the broader CE concept by introducing a definition of the CE. Interviewees were given the opportunity to share any further information that was not discussed during the interview.

Table 14 – Summary of the topic guide used for public interviews

Section	Content of interview's section
1	- Reflection on the survey.
2	- General perception of the diagram.[a,b,c] - Perceived concerns and advantages.[a,b,c]
3	- Perceived hypothetical experience of water reuse, nutrients and energy recovery.
4	- Understandability of the diagram.[b] - Aim, benefits and costs to the society.[a,b]
5	- Perceived personal, societal and environmental concerns and benefits as a consumer, local citizen, and member of the general public.[a,b]
6	- Legitimacy prompts.[a,b,c,d]
7	- Perceptions of the adopting company.
8	- CE definition.

[a] Questions that prompt moral legitimacy. [b] Questions that prompt cognitive legitimacy. [c] Questions that prompt pragmatic legitimacy. [d] Questions that prompt regulatory legitimacy.

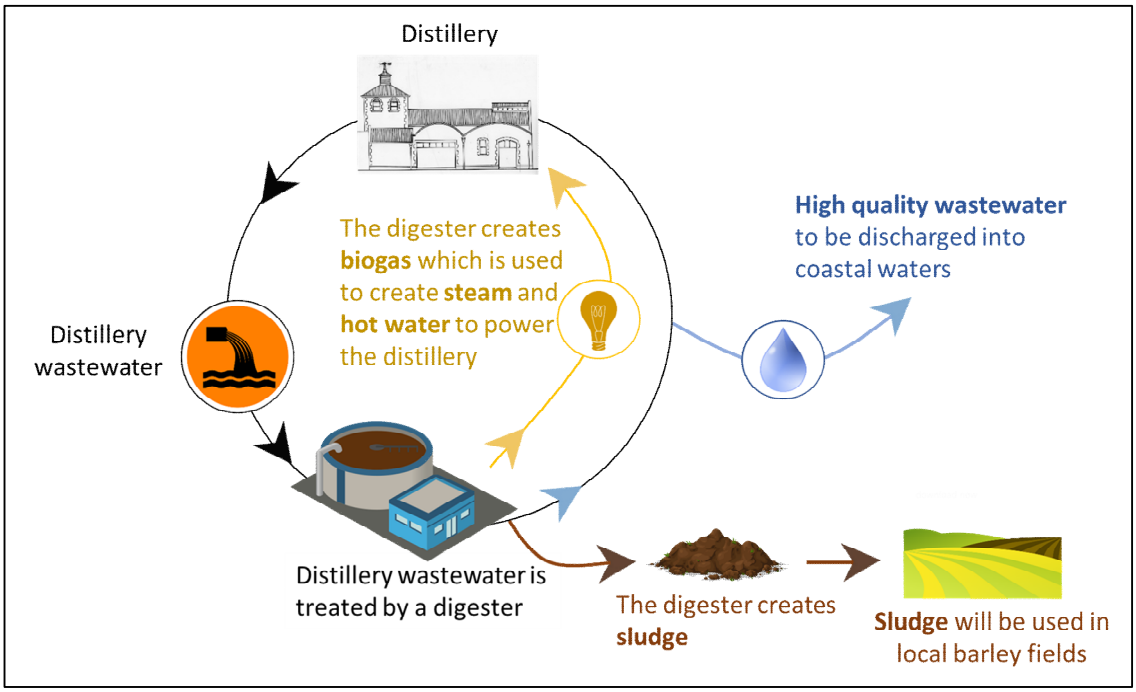


Figure 12 – Diagram inspired from the CE applications in Case C and displayed as part of the public interviews

3.6.3 Data collection

Two interview campaigns were conducted with 56 stakeholders (n=21 for Case A, n=11 for Case B, n=12 for Case C) from February 2020 to March 2022 and with 12 members of the public (n=12 for Case C) in April 2021 (Figure 7). Interviewees were approached via email, and the interviews were scheduled on Zoom or Teams. Interviews with stakeholders lasted between 30 to 60 minutes and interviews with the public between 15 to 30 minutes. Interviewees were presented with an explanation of the general purpose of the study and were probed and asked for clarification as needed throughout the interview (Wilson, 2013). Most of the interviews for cases A, B, and C were performed in English by the main researcher. One interview was performed in Swedish by a local partner who typed and translated the interview back to English (case A, marked in Table 11 by ***). Ten and six interviews with the stakeholders and members of the public, respectively, were conducted for a fourth case (Case D) but were not included in the thesis because the quality of the data was poor, and some consent forms were not returned.

Each interviewee was provided with an informed consent form prior to the interview. The data collection methodology was reviewed and approved by Cranfield University's Research Ethics Committee and was conducted in accordance with GDPR. The reference numbers of the ethical approvals are CURES/12721/2021, CURES/9457/2019, and CURES/12578/2021.

3.6.4 Data analysis

Interviews were transcribed into text files, and the qualitative software NVivo was used for the analysis. A thematic analysis was carried out as it allows for the investigation of differences, relationships and similarities (Gibson & Brown, 2009). Familiarisation with the data was done by reading through the transcripts and taking notes of any repetitive concepts in the data. Transcripts were segmented, and segments were assigned one or more themes that reflected the four legitimacy categories (Guest et al., 2012). The first phase of coding was centred around interviewees' ideas while still following a deductive logic guided by the legitimacy categories and sub-categories established in Section 0. The coding process involved "memoing" or the use of a coding memo to reflect on how the codes may be partitioned between the four legitimacy categories and to create a threshold between the legitimacy categories (Reyes et al., 2021, p. 6). This process required a constant back and forth between the data and the legitimacy literature. As reported by Mackieson et al. (2019), reflexivity is one of the strategies used in qualitative work to strengthen rigour and minimise bias.

In the second phase, the codes were partitioned between the legitimacy categories and sub-categories. In other words, interviewees did not directly refer to legitimacy categories; rather, interviewees' statements were associated with the legitimacy categories by the researcher. When a code fit more than one legitimacy category, it was disassembled into separate codes to fit the relevant legitimacy categories or themes. The coding process resulted in four aggregate themes that were consistent with the four legitimacy categories. The final data structures for stakeholders' interviews in Cases A, B, and C and public interviews in Case C were presented in Figure 19, Figure 20, Figure 21, Figure 22 in

Appendices A.1.3, A.1.4, A.1.5, and A.2.2, respectively. Table 15 provided an example of how one theme emerged from the public interviews data. It shows how interviewees quotes informed the first-order, second-order thematic analysis and theorisation to be integrated into the final data structure (Magnani & Gioia, 2023).

Table 15 – Example of the emergence of a theme from public interviews using a thematic analysis (Adapted from Magnani and Gioia (2023)**)**

Exemplary verbatim	**First-order thematic analysis**	**Second-order thematic analysis, and theorisation**	
"Get people together to give the advantages and disadvantages."	Communication, outreach, education	Pragmatic exchange legitimacy	Pragmatic legitimacy
"[…] benefiting the community that they are not producing waste that someone else's taxpayers pay."	Benefits and disadvantages		
"We don't have an influence on the development of it [CE applications] […] this is just a general sort of position as a citizen."	Influence and shared decision-making	Pragmatic influence legitimacy	
"It just seems they are the smart choice to a competitor […] they have got a better reputation."	Reputational benefits, brand, product	Pragmatic dispositional legitimacy	
"It seems to be a rehash of the concept of greenwashing where companies do tend to try assuming green credentials for their activities. I am just a bit sceptical about the whole thing."	Greenwashing		

Each case study was analysed separately. The number of times a particular legitimacy category and sub-category was coded was used to define the relative level or strength between the legitimacy categories and sub-categories within a case. For each case, the 33.33 and 66.66 percentiles were calculated to allocate each sub-category to one of three 'levels': low (lower than the 0.3333 percentile), moderate (between the 0.3333 to 0.6666 percentiles), and high (higher than

0.6666 percentile). The two percentiles were calculated to generate three equal levels within each case. The levels were put in parallel between the cases in the results Section 4. For instance, a sub-category could be at the same level for two cases, e.g., 'high', based on the count for that sub-category when compared to all the other sub-categories within the case.

Copies of the anonymised data set (public and stakeholders interviews), and the two interview topic guides will be made available on Cranfield University's online research data repository (10.17862/cranfield.rd.14605233 and 10.17862/cranfield.rd.13553717).

3.7 Quality assurance

The multiple quality assurance procedures used in the thesis are summarised in Table 16.

Table 16 – Quality assurance principles and techniques used in the thesis (Adapted from Ritchie et al. (2013) **and Yin** (2014)**)**

Quality assurance principle	Techniques used in the thesis
Construct validity	Converging evidence was developed by combining interviews results from members of the public and various stakeholders from cases studies with different institutional environments. A chain of evidence was maintained to connect the research objectives, the interview topic guides, the evidence that addressed the objectives, and the conclusion. The leader of each case study reviewed the power-interest matrix for the case.
Validity	Explanation building was used to generate an 'explanation' of the legitimacy landscapes for the three case studies, and the connections between legitimacy categories. The sources and strength of legitimacy categories of the three cases were put in parallel in the results sections. The interview questions were designed to capture the phenomena of interest, that is, they reflected the four legitimacy categories, and the thematic analysis was based on the same four categories (Ritchie et al., 2013).

Quality assurance principle	Techniques used in the thesis
Validity	The two interview topic guides were piloted with students from Cranfield University.
Reliability	The internal reliability was ensured by discussing the codebooks for public and stakeholders' interviews with three researchers. One public interview was coded by two researchers. The coding process and the content of the codes were discussed with three other researchers. The external reliability was ensured because sources associated with the four legitimacy categories were consistently reported across the stakeholders and cases, although some variations were identified. Similar sources associated with the four legitimacy categories would likely be reported with other cases and stakeholders (replicability). Two similar interview topic guides were used across the cases and stakeholders for data collection. Therefore, the data collection and analysis procedures are repeatable.

4 RESULTS 1: INTERVIEWS WITH STAKEHOLDERS

This chapter reported results from 44 interviews with stakeholders' interacting with Cases A, B, and C. First, a summary of the main contextual elements of each of the cases and how these interacted with the legitimacy categories was provided in Section 4.1. Second, since this thesis employed a thematic analysis (see Section 3.6.4), the results were reported by themes. For each theme or each legitimacy category, this chapter reported (1) the relative strength of a given theme across the three cases, and (2) what composes the theme including similarities and differences across the three cases. The relative strength of all legitimacy categories across all cases is presented in Figure 17 at the end of Section 4. Finally, the main linkages between legitimacy categories were reported. To support the evidence, illustrative quotes were referenced in the text using the interviewee' number. For instance, [8] referred to a quote from interviewee 8. Some of the quotes were inserted in full in the text. The full list of quotes was provided in Table 24 in Appendix A.1.6. '[…]' can be found in the quotes and indicates that a portion of the quote was removed to bring clarity. When two quotes in the same legitimacy sub-category came from the same interviewee, the same number was used and the quotes in Table 24 were presented in the order these appear in the text. In the instance where two interviewees were interviewed at the same time, the reference in the text took the form of [36&42].

4.1 Interactions of contextual elements of the cases with legitimacy categories

Water reuse in Case A was implemented along with rainwater harvesting as a 'testbed' in a municipal context in Sweden. The testbed was implemented in a rural area that heavily relies on tourism and agriculture. Historically, water management in the area was designed to keep water out of agricultural fields and drain it out to the sea. Consequently, local inhabitants experience recurrent droughts and daily life consequences on vital activities related to tourism, agriculture, and real estate, which related to a strong cognitive comprehensibility

legitimacy. To address water scarcity and issues with water quality, many environmental initiatives including desalination, sea grass removal and reuse by farmers, as well as phosphorus trapping on fields were implemented. Therefore, the testbed was ‘part of the mix’, among many local solutions, which built a strong cognitive taken-for-granted legitimacy. A prominent outreach strategy was orchestrated by a strong network including the municipality, managing organisation, local NGO, farmers, journalists, and a writer. It relied on community of practices, information meetings with local inhabitants and media involvement to bring awareness and comprehensibility and explain benefits related to the testbed. The outreach strategy and the associated network built strong moral structural, pragmatic exchange and cognitive comprehensibility legitimacy categories. Finally, the inclusion of farmers and locals in decision-making related to pragmatic influence legitimacy.

Case B embedded water reuse and nutrients recovery in a mix municipal and industrial context at a brewery in the Netherlands. CE applications were implemented within a historical building containing the visitor centre of a brewery. Therefore, the expectation for appropriate structural characteristics regarding the aesthetic matching the historical building, the pleasant look and smell for visitors and customers and the decentralised design of CE applications was an original feature in moral structural legitimacy for this case. The visitor centre was planned to be used for an outreach strategy, which contributed to building pragmatic exchange legitimacy category. In the context of its brand and reputation, it was perceived that the brewery would get reputational benefits, which referred to a moderate pragmatic dispositional legitimacy. The government strategy provided financial and regulatory support for the implementation of CE applications, which contributed to building a strong moral structural and low regulatory legitimacy respectively. The government strategy encouraged the replication and prevalence of CE applications and environmental initiatives in the sector and the country, which built a strong taken-for-granted legitimacy category. CE applications were implemented within and by a commercial venture (i.e., brewery) which did not allow for decision-making to be shared with locals and visitors and

created a low pragmatic influence legitimacy. Finally, a few reluctant stakeholders were not convinced of the benefits of CE over a linear system, which referred to moral structural legitimacy. As a commercial venture, aspects related to business cases and the financial feasibility and viability of CE applications referred to pragmatic exchange and moral structural legitimacy.

Case C embedded water reuse, nutrients, and energy recovery in the industrial context of a distillery in the UK. The strategies of the Scottish government and distillery sector strongly drove expectations for implementing activities that relate to sustainability and the CE. A strong network of stakeholders, including a sector association and regulators, put in place programmes, facilitated the interpretation of regulations in favour of the CE, and fostered collaboration and exchange of knowledge. The prevalence of initiatives relating to sustainability and the CE in the region and sector was high. All together, these elements related to a strong moral structural, regulatory, and cognitive taken-for-granted legitimacy. In the context of its brand and reputation, the distillery was perceived as a responsible leader that acts for the environment and sets the right example for others to replicate. This referred to a strong pragmatic dispositional, moral consequential, and cognitive taken-for-granted legitimacy. The large scale of the distillery did not allow for decision-making to be shared with the local community which related to a low pragmatic influence legitimacy. There was no planned outreach strategy at the time of the interviews, which related to a moderate pragmatic exchange legitimacy. Similarly to Case B, aspects related to business cases and the financial feasibility and viability of CE applications referred to pragmatic exchange and moral structural legitimacy.

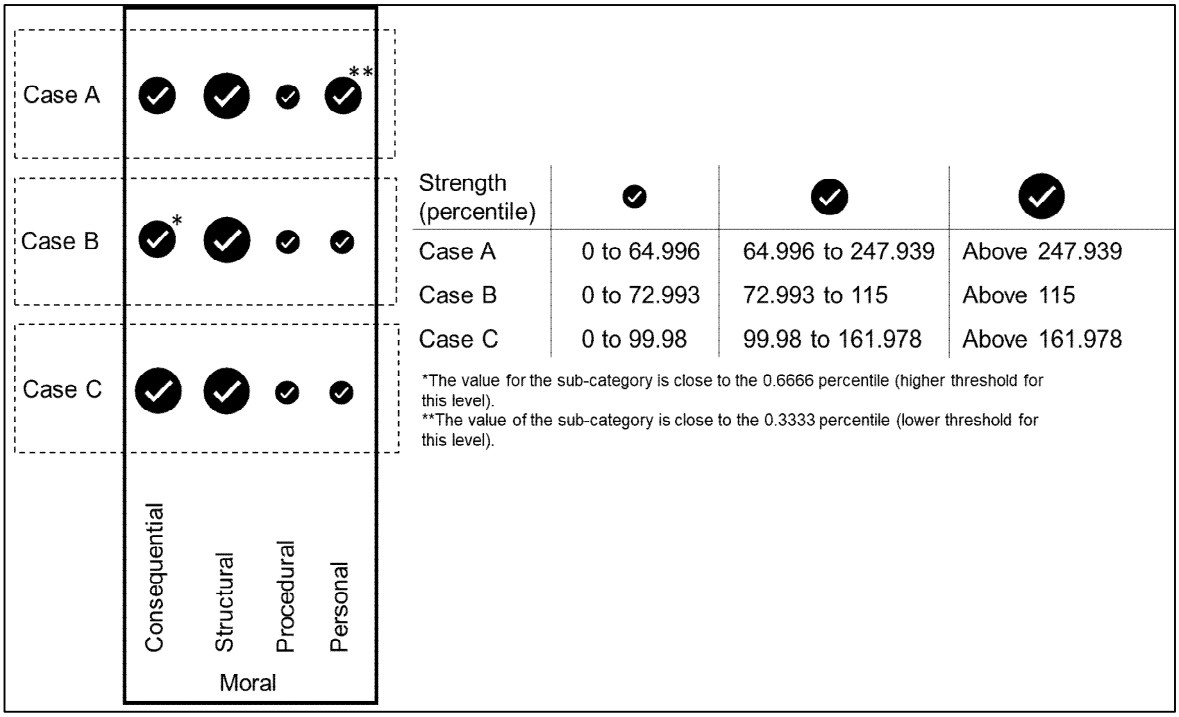
4.2 Moral Legitimacy

In Section 2.4.6, moral legitimacy was defined as based on the active judgment of whether CE applications align with societal values and norms in a manner that enhances societal welfare (Suchman, 1995a; Harris-Lovett et al., 2015). Moral legitimacy was analysed based on four sub-categories: consequential, structural, procedural, and personal legitimacy. Consequential legitimacy referred to the

perceived societal and environmental benefits of CE applications, societal expectations, the storytelling, and example provided by CE applications, whilst structural legitimacy referred to the network embedding the cases, the structural characteristics of CE applications, and sectors strategies. Procedural referred to the procedures that ensure safety and learning among the stakeholders. Finally, personal legitimacy referred to the managing team being involved in the outreach strategy.

4.2.1 Relative strength

Consequential and structural legitimacy were the sub-categories that were referred the most to whilst procedural and personal legitimacy were referred the least to by interviewees across the three cases as shown in Figure 13. Case A differentiated itself from the two other cases in that personal legitimacy was developed by the outreach strategy (see pragmatic legitimacy in Section 2.4.6). Table 17 provides a summary of the main elements associated with each of the sub-categories and cases.



Strength (percentile)	●	●	●
Case A	0 to 64.996	64.996 to 247.939	Above 247.939
Case B	0 to 72.993	72.993 to 115	Above 115
Case C	0 to 99.98	99.98 to 161.978	Above 161.978

*The value for the sub-category is close to the 0.6666 percentile (higher threshold for this level).
**The value of the sub-category is close to the 0.3333 percentile (lower threshold for this level).

Figure 13 – Relative strength of the sub-categories of moral legitimacy across the three case studies

Table 17 – Main elements associated with the sub-categories of moral legitimacy across the three case studies

Sub-category of moral legitimacy	Case A	Case B	Case C
Consequential	**Moderate** (+) Societal and environmental benefits Storytelling and example	**Moderate** (+) Societal and environmental benefits Societal expectation Storytelling and example	**High** (+) Societal and environmental benefits Right thing to do and societal expectation Storytelling and example
Structural	**High** (+) Network Structural characteristics	**High** (+) Network Sector strategy Structural characteristics and contextual criteria	**High** (+) Network Sector strategy Structural characteristics
Procedural	**Low** (+) Procedures to ensure the quality and safety of derived products.	**Low** (+) Procedures to ensure the quality and safety of derived products and for stakeholders to address challenges.	**Low** (+) Procedures to ensure the quality and safety of derived products.
Personal	**Moderate** (+) Outreach strategy	**Low** (+) 'Environmental café'	**Low**

(+) sources that drive legitimacy; (-) sources that challenge legitimacy

4.2.2 Consequential Legitimacy

One aspect of consequential legitimacy related to whether CE applications promoted societal welfare. These benefits were locally oriented in Case A, and concerned an increase in water availability which would develop the local society activities, such as tourism, farming, and real estate [25]. These related to the broader picture in Case B: *"[…] what they have to realise is not the gain on the water resources, on the water price, which is important, [it] is the gain on the*

pollution and on the water resources and the overall impact because if you purify water then […] the ecosystem locally [is] much more […] resilient, optimised, robust efficient […]. It will be an impact on the agriculture, […] on the health, […] on the quality of the air […]. […] you are talking about the impact it could have on […] the society living there and, on the biodiversity, […]" [13]. Similarly, the uptake of CE applications in Case C was initially fostered by the increased awareness of the distillery's consequential impact on the environment and a willingness to reduce the distillery's and the sector's environmental impact (e.g., carbon footprint) [47]. However, it was also perceived that the impacts of CE applications are "a drop in the ocean" at the society scale [35], and that derived products may damage the environment, with for instance, the increase risk of eutrophication due to fertilisers in Case C. Perceptions that CE applications are the right thing to do were associated with societal expectations for the protection of the environment and perceived societal benefits of such applications, including, the reduction of carbon emission and pollution, and an improved resource management in Case C. There was a societal (and a sectoral for Case C) expectation for companies to act in favour of the environment, by for instance, adopting CE applications due to current rising awareness about climate change (all) [47; 19].

In Case A, the testbed was at an early stage at the time of the interviews. Therefore, members of the local community expressed high expectations regarding the consequential outcomes of the testbed (i.e., water quantity) and there was a desire to show that CE applications are workable [5]. More broadly, the storytelling about the CE applications was perceived to showcase an inspirational example to encourage or apply pressure on others to replicate (see cognitive legitimacy in Section 4.3.3) (all) and an authentic case of a company (see pragmatic legitimacy in Section 4.4.4) that cares about the environment in Cases B and C. The storytelling was also perceived to demonstrate the technical feasibility of a sound and safe technology (all) [7] and the economic viability of the CE applications that is good for businesses (Cases B and C), which could set a new standard [29]. More specifically to Case B, CE applications were seen as

a good example of how technologies can be integrated in an urban environment, and it was perceived that the storytelling about the case will be achieved through the visitor centre. The provision of concrete results was expected in all three cases and was perceived as improving CE perceptions, acceptance in Case B and alleviating greenwashing associations in Case C (see pragmatic legitimacy in Section 4.4.4). However, outcomes were perceived as uncertain. Uncertainties included, for instance, an expensive technology, technical challenges to develop and run the CE applications, and a high energy consumption in Cases B and C [10].

4.2.3 Structural Legitimacy

Structural legitimacy mainly related to the networks of stakeholders that supported CE applications in the three cases. The structural capacity of the implementing organisations to develop CE applications was built with a legitimate and heterogeneous network in Case A: *"they chose [location] because they had connections here […] is it important to have the scientific knowledge, it is important to have the financial means to be able to do this project, but […] the most important thing is to have the local anchoring or legitimacy"* [30]. In Case B, the network that embedded CE applications included passionate and innovative leaders from a private company and a water board, who were convinced about the CE benefits and personally drove the adoption of CE applications [7; 24; 7]. Moreover, networks included actors who signalled a good disposition for having the community best interest at heart in Case A [30]. It also included actors who are credible in the sector, which was illustrated by the partnership with an environmental association for the outreach strategy of CE applications that were previously implemented in Case C. Finally, networks included stakeholders who are perceived as skilled for dealing with local water issues in Case A and performing a CE 'job' in Case C, as well as influential actors who developed one of the most advanced treatment systems in the water sector and are experienced in dealing with water treatment technologies (e.g., space sector in Case B).

Stakeholders with different expertise, including regulators and technology providers, came together to form strong collaborations (all) and engaged in long-term partnerships (Case B), which was perceived to provide a learning opportunity to exchange knowledge within and across sectors and develop skills to make CE applications (all). A strong network may have encouraged the adopting company to uptake CE applications in Case C.

Although networks were perceived as heterogenous, legitimate, nurturing, and 'fit for the job', concerns were raised by one interviewee in Case B who mentioned that some stakeholders were reluctant to adopting the CE, challenged the CE principles, and were not convinced about the benefits attached to CE applications: *"Some of them [stakeholders] were very convinced, others were […] not sure that circular system are better than open ones. I heard a few people who say I am not convinced that the closed systems are better than the open […] I think it's not elaborated […] as I explained, you have an obstacle and you think if you say this obstacle doesn't exist, we don't need this […] a bit disappointed"* [13]. Another interviewee challenged the technical appropriateness of the technology to be implemented in Case B with regard to dimensioning challenges. More broadly, stakeholders may not possess the required skills and good practices to perform in a CE context (Case B) [13] and businesses may lack the understanding of the CE (Case C).

Structural legitimacy was further reinforced by perceptions that current economic and supply chain models are hard to change and do not provide the structural capacity to support the development of the CE, although it was generally agreed that current models are damaging for the environment and that more responsible and circular systems are needed [48]. Identifying the right business plan and economic strategy that makes financial sense for the adopting company were perceived as essential, although challenging, for CE applications to be viable [24].

Strategies of the distillery sector for Case C and the government for Cases B and C developed structural legitimacy [37]. The long-term environmental and sustainability strategy of the sector in Case C included the CE as one of the main

themes: *"The sector as a whole is aiming to be carbon neutral by, I think […] 2040 they have got in their strategy. And the [organisation] strategy has been signed up by all members companies. […] they do place a very high value as a sector on environmental performance"* [36&42]. Moreover, government strategies provided financial resources to invest and develop activities that save water, such as water reuse, in Case B [10].

The structural characteristics of the technology were an essential feature in Case B [7]. CE applications had to meet the required criteria of the implementing organisation meaning that CE applications had to fit in a historical building and a visitor centre and adopt a decentralised and local design. Overall, the physical and structural characteristics and challenges of CE applications included for instance, the efficiency, appropriate and functioning technology and treatment to generate safe output and meet water quality requirements in all cases. More specifically, there were concerns regarding the physical characteristics of fertilisers derived from wastewater which may require the addition of nutrients if the sludge was left with low value, although it was the preferred alternative when compared to fertilisers that are not produced locally and that have to be shipped elsewhere (Case C).

The distillery sector was perceived to have the financial ability to make big investments for CE applications, which reinforced the structural capacity of the adopting company and ultimately of the sector to develop CE applications for Case C. Interviewees of Cases A and B expressed the importance of having long-term financial support from the government to afford initial investments. Stakeholders reported that risk perceptions would likely be the highest for farmers and referred to examples of episodes of contaminated sludge observed in other countries which would likely lead to farmers being sceptical to using products, like fertilisers produced with nutrients derived from CE applications [13].

4.2.4 Procedural Legitimacy

Discussion about procedural aspects was minor in the three cases and focused on the best practices learnt as part of the trials and problem solving for the cases.

More particularly, procedural legitimacy referred to the lack of procedures (and knowledge of) how to solve challenges related to the development of the CE in Case B [13]. Moreover, procedural legitimacy referred to data monitoring, procedures, testing, and control to ensure water quality. Risk perceptions were associated with risks of contamination with bacteria, pharmaceutical and heavy metals [12, 39]. Interviewees reported that the public would be likely to think of CE applications and derived products as safe if appropriate procedures and certifications were put in place in all three cases [33].

4.2.5 Personal Legitimacy

The outreach strategy (see pragmatic legitimacy in Section 4.4.2) developed personal legitimacy in that the manager of the water board and a trusted member of a local organisation talked personally to the local community in Cases A [2]. Personal legitimacy was limited to the water board manager talking personally to local inhabitants at 'environmental cafés' in Case B [10] and was absent in Case C at the time of the interviews.

4.3 Cognitive Legitimacy

In the typology for this research (see Section 2.4.7), cognitive legitimacy was defined as based on the passive assumption that CE applications align with daily life and cultural frames and are perceived as inevitable (Harris-Lovett et al., 2015; Suchman, 1995). Cognitive legitimacy was analysed based on two sub-categories: comprehensibility and taken-for-granted. Comprehensibility referred to the understanding and awareness of CE applications and the relation with stakeholders' daily life routines, and cultural frames that provide plausible explanations for these applications. Taken-for-grantedness referred to the inevitability and replicability of CE applications, the absence of negative perceptions, and the associations with taken-for-granted practices.

4.3.1 Relative strength

Cognitive comprehensibility legitimacy was the strongest in Case A and moderate in Cases C and B, as shown in Figure 14. Taken-for-grantedness legitimacy was

equally as strong in all three cases. Table 18 provides a summary of the main elements associated with each of the sub-categories and cases.

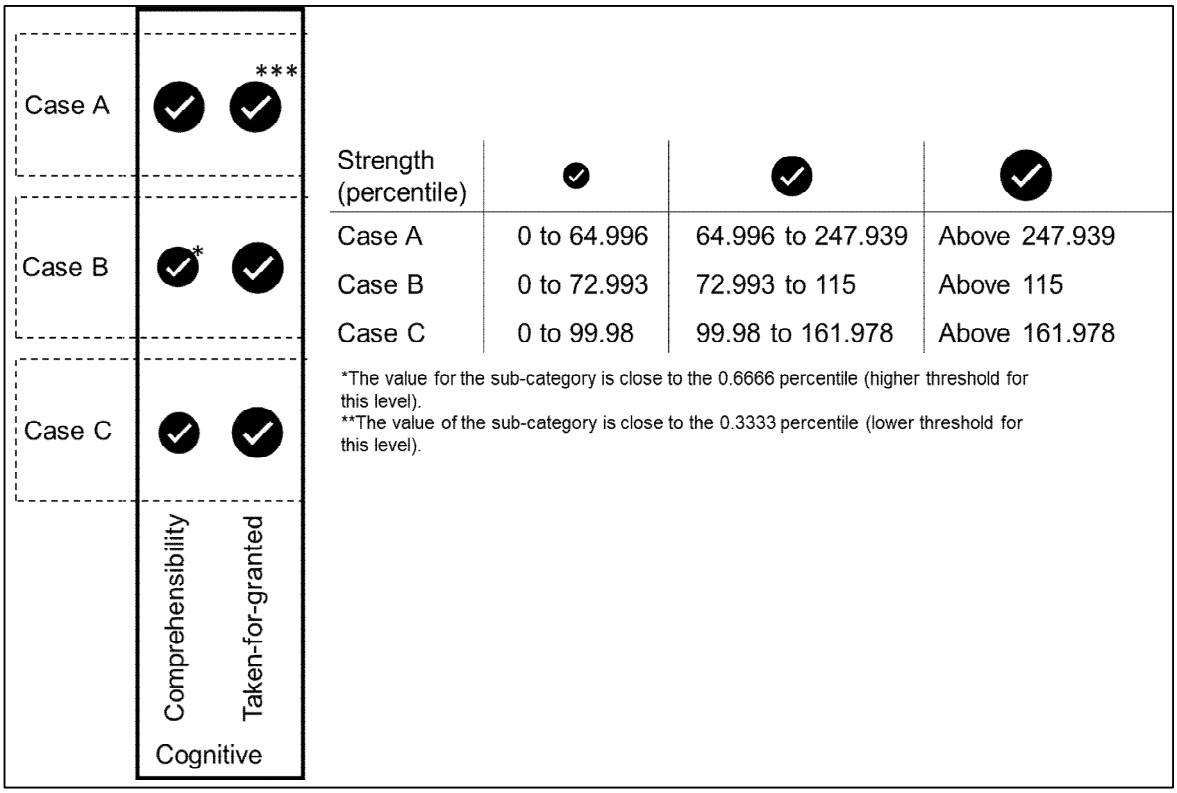


Figure 14 – Relative strength of the sub-categories of cognitive legitimacy across the three case studies

Table 18 – Main elements associated with the sub-categories of cognitive legitimacy across the three case studies

Category of cognitive legitimacy	Case A	Case B	Case C
Comprehensibility	**High** (+) Experience and awareness of drought and environmental challenges, outreach to increase understanding, awareness,	**Moderate** (+) Environmental challenges, visitor centre to increase understanding (-) Low local awareness,	**High** (+) Environmental challenges, outreach to increase understanding (-) Low local awareness, low realisation of impacts

Category of cognitive legitimacy	Case A	Case B	Case C
Comprehensibility	embedded in local projects (-) low realisation of impacts	low realisation of impacts	
Taken for granted	**High** (+) Replication, inevitability, embedded in local taken-for-granted practices, low negative perceptions	**High** (+) Replication, inevitability, aligns with sector's strategy, low negative perceptions	**High** (+) Replication, inevitability, aligns with sector's strategy and history, low negative perceptions

(+) sources that drive legitimacy; (-) sources that challenge legitimacy

4.3.2 Comprehensibility Legitimacy

Cognitive comprehensibility was represented by interviewees referring to daily life experiences at a local scale for Case A and sectoral or industrial scale for Cases B and C. The testbed was connected to the persistent drought affecting the daily life of the local community and the economic development of the local area, including agriculture, businesses, real estate in Case A [3]: *"The situation in [location of Case A] […] it has been so severe for so long, this lack of water, […] it has been so obvious to the people of [location of Case A] […] most people are very grateful that we are no entering an era of really practical solutions"* [18]. Moreover, CE practices were perceived as common in the daily lives of local inhabitants in Case A, which included rainwater harvesting and indirect water reuse at home [20]. The local 'open culture' in Case A [23], the perceived Dutch innovativeness with regard to the CE in Case B, and growing concerns and awareness about climate change and environmental protection (all) increased the comprehensibility of CE applications as 'making sense'.

Another aspect of comprehensibility legitimacy regarded the awareness and understanding of CE applications. There seemed to be a relatively high

awareness of the testbed amongst the local community in Case A, whilst the awareness of CE applications in Cases B and C at a local level was perceived as low given the remote locations of these applications. CE applications, however, seemed popular and well known among water practitioners and visitors due to high media attention in Cases A and B [2; 10]. There were concerns about whether locals (all), farmers (all), and customers (Cases B and C) would relate to and see the local and societal impacts of CE applications [8]. In all three cases, the ability of farmers, locals, and customers to relate to and see the impacts of CE applications was perceived to depend on the outreach strategies at the local meetings in Case A, and visitor centres and brand marketing in Cases B and C (see exchange pragmatic legitimacy in Section 4.4.2). CE applications in Case A were not framed as 'water reuse' but as a 'testbed' and 'part of the mix' of solutions along with rainwater harvesting and groundwater testing which made it harder to disentangle water reuse from other solutions [31]. Interviewees in Case B perceived that the planned outreach strategy would increase visitors' awareness and comprehensibility of the CE, the water cycle and treatment by embedding CE applications within places, such as the brewery and the attached restaurant, that are routinely visited: *"There are a lot of visitors there every year [visitor centre] […] ordinary people can learn what you can do with water"* [10]. Interviewees perceived visitors as conveyers of the CE concept which was seen as increasing the understanding of the CE as a whole and changing perceptions and behaviours about waste and water in Cases A and B. CE applications were perceived as an opportunity to increase the awareness of such applications, the CE and the environment in all three cases [19; 45]. There was a perceived lack of understanding about the CE among businesses and the public [43; 48]. Stakeholders perceived that the communication about CE applications may rather be placed within the overall picture of how it helps with sustainability, carbon emission reduction.

4.3.3 Taken-For-Granted Legitimacy

Stakeholders reported interests in replicating CE applications to other breweries in Case B, distilleries in Case C, and any industry handling wastewater in all

cases [18; 14; 43]. CE applications were perceived as ones that could be replicated if financial and technological aspects were successfully demonstrated. Promoting a storytelling about CE applications (see moral consequential legitimacy in Section 4.2.2) was perceived as encouraging and pressurising for organisations within the sector and beyond to any sector producing wastewater to further adopt the CE in Case C. Indeed, foreign companies and governments signalled their interest to replicate CE applications [3; 10]. Additional opportunities and a willingness to add features to existing CE applications were mentioned in Cases B and C. Additional opportunities included water fit for bottle rinsing and irrigation, and the exchange of by-products with farmers in Case B [14]. Interviewees in Case C perceived opportunities to share recovered heat [39], and have synergies between organisations, such as between the distillery, farmers and a maltster [44].

Another aspect of taken-for-granted legitimacy referred to perceptions that CE applications and the CE were the ‘way to go’ for the future and were seen as inevitable with regard to the way society works (e.g., unsustainable resource management) in all three cases [25; 14; 43]. Additionally, the experience of the long-term drought in Case A, led to perceptions that the testbed was inevitable.

CE applications were embedded in similar initiatives and practices and interviewees connected CE applications to taken-for-granted practices, such as sustainability. In Case A, CE applications evolved among many solutions that aim to increase water quantity and improving the water quality of local water bodies, which were originally developed to fight the drought and prompted the uptake of water reuse later on [6]. CE applications in Case C were an extension of CE applications that were implemented a few years earlier, and were among CE applications applied across the distillery and beverage sectors [16; 29]. The CE was perceived as an established and prevalent, almost historical practice that is taken-for-granted in the beverage sector, and that aligned with the sustainability and environmental strategies of the sector [37].

Finally, the taken-for-grantedness of CE applications (all) was further reinforced as very few concerns, negative perceptions, and oppositions were reported by interviewees. However, CE applications were challenged on a technical (e.g., efficiency, quality) and financial grounds in the three cases. The CE application in Case A was not seen as the only alternative but as 'part of the mix' of solutions that would provide more water to the local area [3]. Similarly, it was perceived that CE applications in Case C should be applied alongside other solutions for an overall reduction of the carbon footprint [39].

4.4 Pragmatic Legitimacy

The thesis typology (see Section 2.4.8) defined pragmatic legitimacy as based on the self-interested calculations about the benefits provided by CE applications to various stakeholders (Harris-Lovett et al., 2015; Suchman, 1995). Pragmatic legitimacy was analysed based on three sub-categories: exchange, influence, and dispositional legitimacy. Exchange legitimacy referred to the perceived value or benefits provided by CE applications and the associated outreach strategies. Influence legitimacy was based on the perceived incorporation of stakeholders in decision-making processes, and dispositional legitimacy referred to perceptions that adopting organisations are trustworthy and have a good reputation.

4.4.1 Relative strength

Exchange legitimacy was mainly represented by perceived benefits to a wide range of stakeholders and outreach strategies. Exchange legitimacy was high in Cases A and B and moderate in Case C. Whilst the outreach strategy was highly developed and referred to in Case A, outreach strategies in Cases B and C were planned or absent due to the early stage of the cases and were referred to relatively less. Influence legitimacy was discussed the most in Case A, whilst it was discussed the least in Cases B and C and was associated with a perceived lack of involvement in decision-making. Dispositional legitimacy was the strongest in Case C, followed by Case B and Case A. Whilst it was materialised by the presence of trusted local actors in Case A, Cases B and C touched upon the branding and marketing associated with the implementing company.

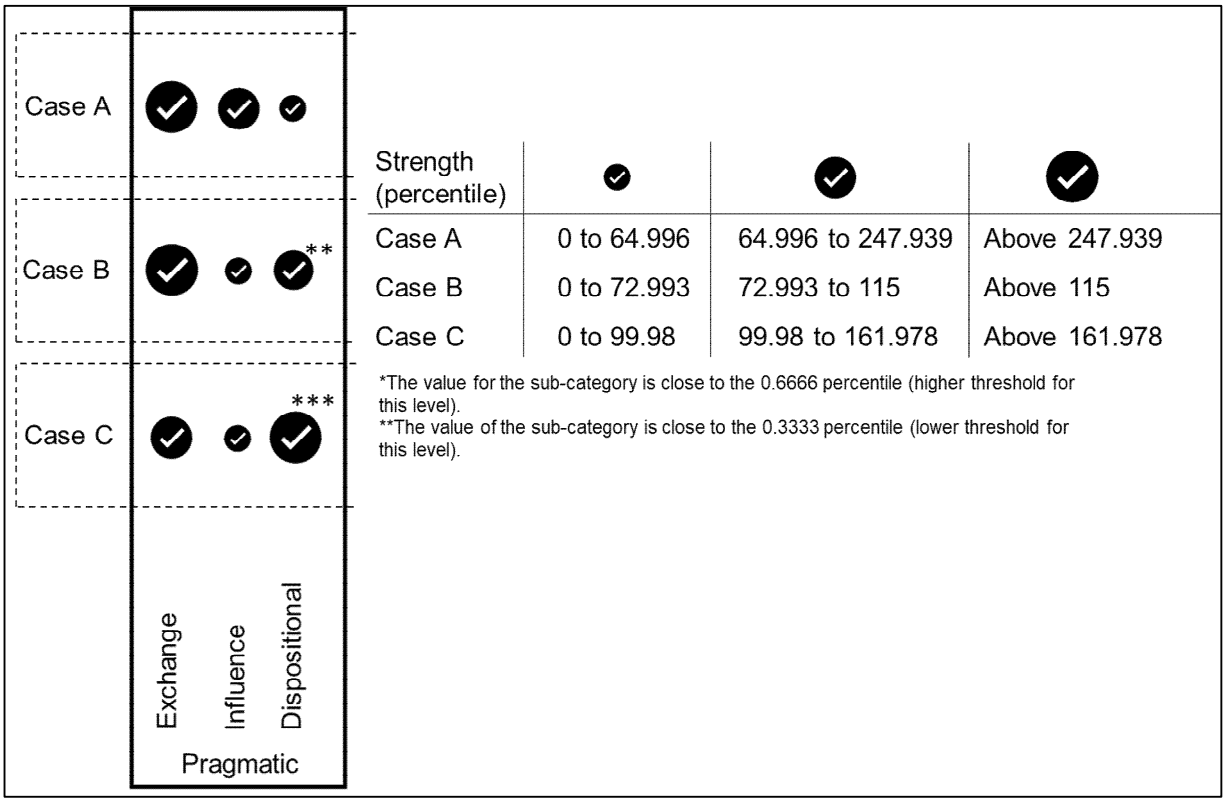


Figure 15 - Relative strength of the sub-categories of pragmatic legitimacy across the three case studies

Table 19 – Main elements associated with the sub-categories of pragmatic legitimacy across the three case studies

Category of pragmatic legitimacy	Case A	Case B	Case C
Exchange	High (+) Intense outreach strategy (+) Locals and stakeholder's benefits	High (-) Low outreach strategy (+) Plan for future outreach, stakeholders' benefits.	Moderate (-) Low outreach strategy (+) Stakeholders and sectoral benefits.
Influence	Moderate (+) Local community involvement.	Low (-) No shared-decision making. (+) Opportunity to provide feedback.	Low (-) No shared-decision making. (+) Opportunity to provide feedback.

Category of pragmatic legitimacy	Case A	Case B	Case C
Dispositional	Low (+) Trusted local organisations.	Moderate (+) Branding benefits.	High (+) Societal expectations and branding benefits.

(+) sources that drive legitimacy; (-) sources that challenge legitimacy

4.4.2 Pragmatic Exchange Legitimacy

The main perceived benefits for Case A were benefits at a local scale [4; 6]. It was perceived that the testbed would increase the quantity of water available to allow for tourism, businesses, real estate, and the local community more broadly to develop further: *"I know that if they would have a very, very much better water situation, I think more people would build houses in [location], there would be more people moving to this part of [location], and that would of course have very, very positive effects"* [18]. However, a minor uncertainty was raised about whether the testbed would provide benefits. For Cases B and C, benefits to the local community were limited to agricultural benefits due to the isolated location of the cases. Agricultural benefits included an increase in local water availability for farmers for Cases A and B [24] and a reduction of the reliance on artificial fertilisers which was perceived to benefit the crops and decrease the overall carbon footprint of farmers for Case C [35]. A few interviewees thought that convincing farmers about the sludge benefits would take a long time [35].

Perceived benefits to technology providers and CE practitioners were a common element in all three cases. Perceived benefits included the spread, development, and increased awareness of providers of CE applications and technologies for Cases A and B [24] and the opportunity to test and get feedback on the technologies for Cases B and C. Moreover, benefits to CE practitioners, adopting companies, and regulators to a lesser extent, included valuable lessons learnt and best practices that could be transferred across various sectors [29; 37], such as the knowledge of the current challenges to implement the CE and how to make a system circular.

Finally, perceived benefits were also financial in all three cases. They mainly referred to the perceived financial long-term benefits and associated financial resilience of CE applications, such as increased sells [34] and reduced running costs along the supply chain for case C [46], the economic development of the local community for Case A, a reduction of water consumption and a source of income for Case B [8; 13]. Moreover, CE solutions were perceived as cheaper options when compared to competitive solutions such as desalination plants or conventional centralised systems for Case A.

A second aspect of exchange legitimacy regarded outreach strategies. Whilst the outreach strategy in Case A was most importantly about communicating about the testbed to the local community, those planned in Cases B and C involved communication with customers using a visitor centre (Case B) and through marketing (Case C). In Case A, project leaders continuously collaborated with a local association to inform and work with local landowners and farmers to gain local knowledge which was perceived as a key factor to success. Moreover, project leaders invited the local community to meetings to talk about the testbed and disseminated information about the diverse solutions including the testbed and their impacts through various routes, including the local media and a book [17; 3]. However, the final decision about which technology would be chosen was not communicated at the time of the interviews. Overall, a successful outreach strategy was made possible with a strong network of stakeholders (see moral structural legitimacy in Section 4.2.3). Despite an intense outreach strategy, one interviewee stressed that information about the testbed was hard to access.

By contrast, the outreach strategies of Cases B and C were relatively limited, particularly because the cases were at an early stage. Local inhabitants took part in local meetings in which one of the project leaders introduced CE applications and addressed questions in Case B [10]: *“Sometimes I get invited in local meetings […] there are lots of people and you can tell them about this project”*. A highly attended visitor centre including CE applications was planned to be used in Case B for outreach work to show and explain the project and its impact [16]. While there was no plan for an outreach strategy in Case C at the time of the

interviews, interviewees mentioned that the outreach strategy implemented for previous CE applications, which was performed by a conservation organisation, could be replicated for the novel CE applications [37]. Communication strategy, marketing, and storytelling about CE applications were equated [43]. It was expected to include information about the CE concept and environmental benefits (e.g., reduction of carbon footprint) for the public and stakeholders in the sector and beyond, through brand marketing, storytelling in the media, and the visitor centre to a lesser extent.

Communities of Practice – a group of stakeholders discussing the case study dynamics – were used to engage various stakeholders in Case B (e.g., regulators, and technology providers), and allow them to influence the development of CE applications and learn from each other. The importance of communication and collaboration with stakeholders was also raised in Case C [43]. Finally, the outreach strategy also included project leaders disseminating information about the testbed in Case A and CE applications in Case B in the local, national and international media. While Cases A and B received wide media coverage, Case C did not receive as much attention due to the early stage of the project.

4.4.3 Pragmatic Influence Legitimacy

Influence legitimacy was based on the perceived incorporation of stakeholders in decision-making processes. Whilst the local community was involved in Case A, there was no plan to share decision-making in Cases B and C. Part of the outreach strategy for Case A, described in Section 4.4.2, addressed influence legitimacy. Project leaders invested considerable time involving a small proportion of the local community to gain local knowledge [5]: *"[…] they [landowners and farmers] feed in a lot of information. It could be experiences regarding water, […] they could have good ideas to solve issues and challenges both technical but also regarding how to inform and how to discuss with the locals"* [2]. Moreover, the local community may have influenced the uptake of water solutions including the testbed as a result of the daily experience of the

drought [3]. It was perceived that main stakeholders would take the final decision about the testbed, unless local inhabitants were directly affected by the testbed.

For Cases B and C, there was no indication that sharing decision-making was a priority [14]. One interviewee mentioned that *"they would want to inform people about it. I am not sure they would necessarily engage them in the decision-making process directly in this case"* [47]. Reasons expressed for not sharing decision-making included perceptions that CE applications would be too technical for the public to understand [47], and perceptions that the host building for CE applications was a private, religious and historical place in Case B [16]. Moreover, community consultation was also seen as creating friction if suggestions were to not be taken on board at the end of the process in Case C [48]. Opportunities for the public and the local community to influence CE applications were only perceived to include the provision of ideas to a 'board of ideas' [10] and the provision of feedback and suggestion to the adopting company [34]. Decision-making was very much limited to stakeholders who were integral to the development of CE applications.

4.4.4 Pragmatic Dispositional Legitimacy

Dispositional legitimacy was based on perceptions that adopting organisations and associated stakeholders were trustworthy and had a good reputation. Dispositional legitimacy in Case A related to the perceived trustworthiness of a network of organisations and actors that was perceived as legitimate locally. In Cases B and C, dispositional legitimacy related to perceptions of the brand and reputation of the adopting companies.

Dispositional properties were conferred to stakeholders of the network embedding the testbed, which was considered legitimate in Case A. The network included the implementing organisation and a local association that were seen as trustworthy [30]. Perceptions of the adopting company's brand were both a driver and a consequence in Case C. Interviewees perceived that to preserve positive perceptions towards the brand, the organisation had to 'do the right thing' [48]. CE applications were perceived as 'the right thing' to do to match the

increasing societal expectations for more ethical and environmental choices (see moral consequential legitimacy in Section 4.2.2). On the other hand, perceptions that CE applications were 'the right thing' meant that the adopting organisation, the associated sector, and products (i.e., whisky) displayed dispositional attributes, such as being perceived as ethical, having a good character and being a pioneer [39; 48]. Consequently, CE applications were perceive to have a positive impact on the brand perceptions, which made the organisation visible to customers, investors and regulators, and differentiated it from competitors: *"[…] any brand that is involved in recycling of any sort and showing that they are being as kind as possible to the environment, this can only be a positive for the company […] and the brand associated with it"* [46]. Similarly, the uptake of CE applications in Case B was seen to confer the adopting organisation a good disposition (e.g., authentic) [29; 24], which could strengthen the brand in the context of an increased environmental awareness within the society. However, the brand image could also be damaged if CE applications were associated with greenwashing activities and challenged public perceptions (e.g., bad smell, technical challenges) in Cases B and C [14]. Demonstrating genuine positive environmental impacts through a transparent storytelling was perceived as essential to prevent greenwashing associations in Case C [36&42].

4.5 Regulatory Legitimacy

The typology developed in Section 2.4.9 defined regulatory legitimacy as the capacity to set up rules and assess others' congruence to them (Harris-Lovett et al., 2015; Scott, 1995). Perceptions associated with regulatory legitimacy included driving, emerging, and constraining regulatory aspects as well as opportunities to update current regulations and supportive regulators.

4.5.1 Relative strength

Regulatory legitimacy category was the least referred across all four legitimacy categories for all three cases. The strength of regulatory legitimacy was low in Case A and moderate in Cases B and C, as shown in Figure 16. Table 20

provides a summary of the main elements associated with each of the sub-categories and cases.

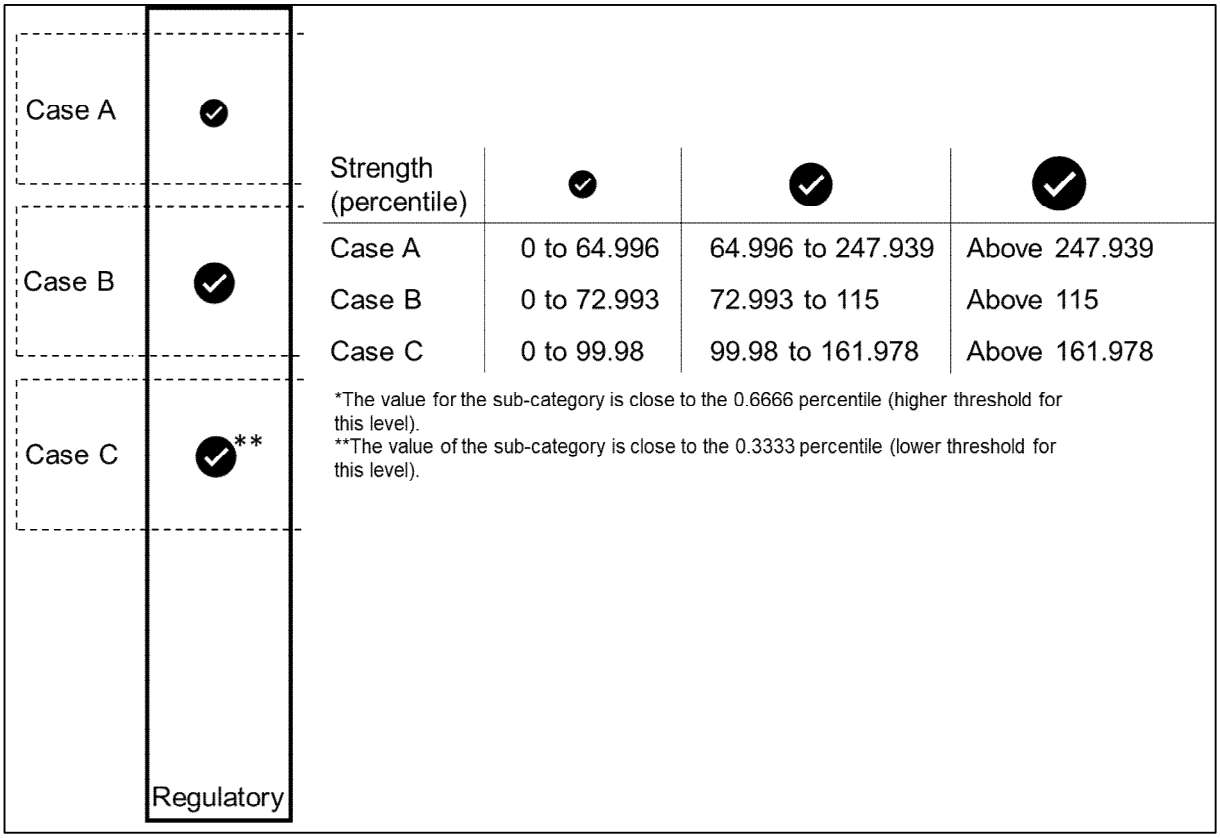


Figure 16 - Relative strength of regulatory legitimacy across all three case studies

Table 20 - Relative strength of regulatory legitimacy across the three case studies

Legitimacy category	Case A	Case B	Case C
Regulatory legitimacy	**Low** (+) Emerging regulations and supportive regulators (-) Lack of CE regulations	**Moderate** (+) Emerging regulations and government program, regulations prompted adoption, supportive regulators (-) Lack of CE regulations, context specific regulatory constraints	**Moderate** (+) Emerging government and sectoral program, growing regulations to favour the environment, regulations prompted adoption, supportive regulators (-) Lack of CE regulations, context specific constraints

(+) sources that drive legitimacy; (-) sources that challenge legitimacy

4.5.2 Regulatory legitimacy

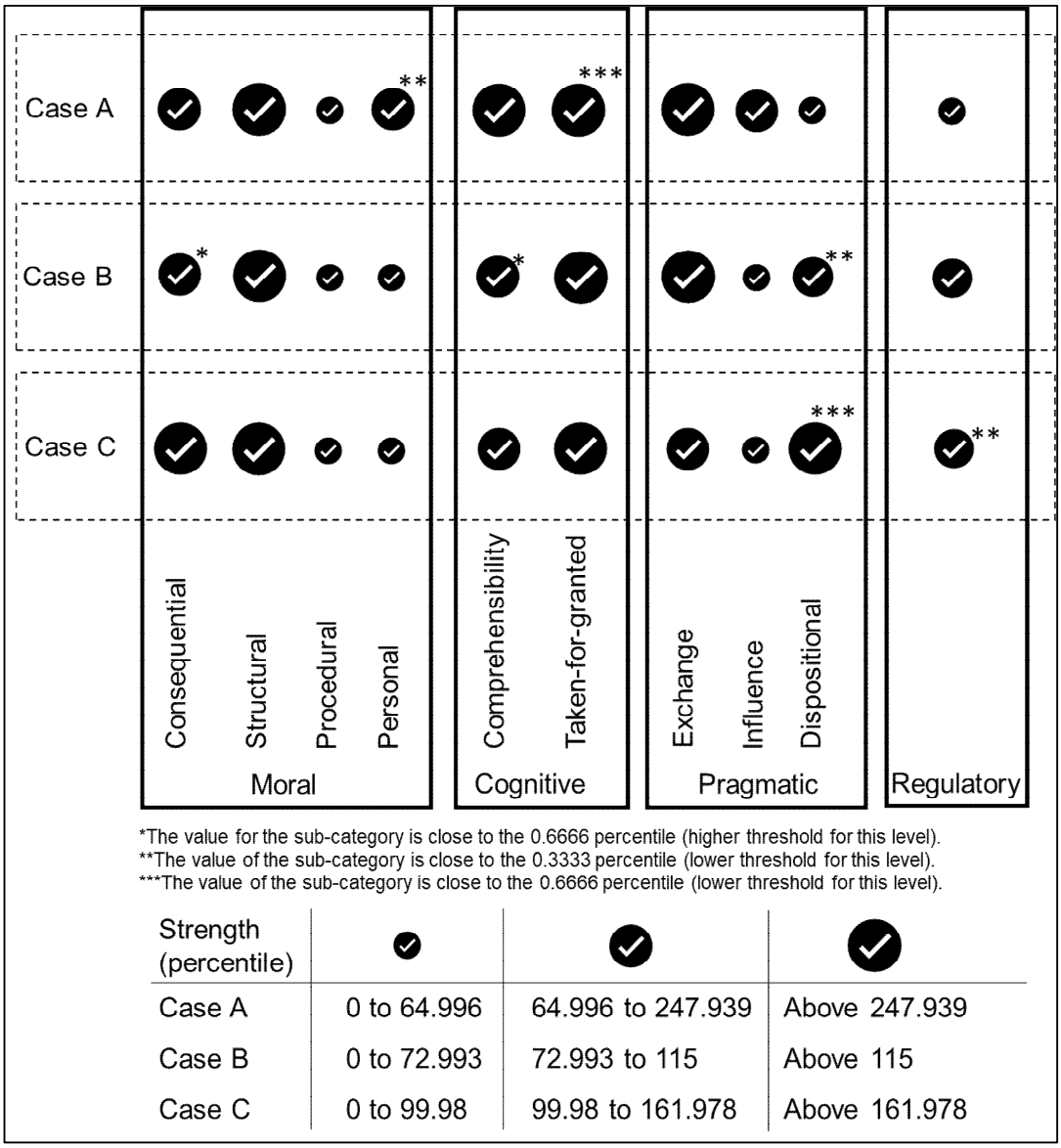
The adoption of CE applications for all three cases was partly prompted by some regulatory aspects. The adoption of the testbed and other water-related projects was encouraged by water use restrictions due to the persisting drought in Case A [30]. With regard to Case B, the implementing organisation needs for a technology that could meet established standards and prevent fines fostered the uptake of CE applications [8]. Finally, although interviewees mentioned that there was no legal requirement to adopt CE applications in Case C, the adoption seemed to have been encouraged by regulators and the sustainability and environmental strategy of the sector [36&42].

Emerging national and sectoral regulations and programs drove the adoption of CE applications at all three cases. Emerging national regulations seemed to have contributed to the uptake of CE applications in Cases B [8] and A: "*There are very good initiatives in Sweden, and I think that this is the reason of the project, to test and evaluate the innovative solution in order to find circular technologies and systems for future water supply solution*" [5]. Moreover, emerging governmental programs that target the CE, sustainability and water management and provide financial support encouraged the adoption of CE applications in Case B [14]. Finally, the strategy, targets, and high regulatory burden of the distillery sector and the Scottish government to encourage business to reduce carbon, water, and energy footprints fostered the uptake of CE applications in Case C [36&42]. Regulators were highly supportive of the development of CE applications in all three cases [2; 36&42]. Having regulators on board created opportunities to update relevant regulations in all three cases and to demonstrate the need for CE regulations in Cases B and C [10; 37]. Risk perceptions were linked to regulatory legitimacy in that complying with appropriate laws and regulations could ensure health safety [47].

Interviewees in Case C added details about the future direction of regulatory legitimacy. There were expectations that regulations would tighten in favour of

the environment in the future [34]. Moreover, it was perceived that the adoption of CE applications in Case C and of CE applications more broadly may lead to the uptake of CE regulations [34].

Although existing and emerging regulations promoted CE applications, regulatory challenges were reported by interviewees. Interviewees in the three cases reported outdated laws and a lack of regulations, which meant that a CE could not be supported adequately [2]. One interviewee in Case B reported: *“But if you really look what is in the law [related to circular economy], I don't think there's anything really there*” [14]. Regulatory challenges almost halted the uptake of CE applications in Case B [29]. One particular comment highlighted the need for transitional regulations that allow for practitioners to trial CE applications without being fined for not instantly complying with current standards [14]. It was perceived that current regulations tended to classify nutrients recovered from wastewater as waste which constrained the development of such applications and innovative models (Case B and C) [10; 48]. Regulatory constraints were also context specific. Whilst CE applications in Case B had to comply with regulations about the historic heritage of the building, those in Cases B and C had to comply with food regulations of the beverage sector [13; 45].



Strength (percentile)			
Case A	0 to 64.996	64.996 to 247.939	Above 247.939
Case B	0 to 72.993	72.993 to 115	Above 115
Case C	0 to 99.98	99.98 to 161.978	Above 161.978

Figure 17 - Summary of legitimacy strength across the three case studies and cross-cutting themes

4.6 Linkages between legitimacy categories

The main links between legitimacy categories are displayed in Table 21.

Table 21 – Illustrative quotes showing the main links between legitimacy categories for stakeholders' interviews

Connecting legitimacy categories	Nature of the connection	Illustrative quotes
Pragmatic exchange and cognitive comprehensibility	Outreach strategy to increase the understanding of CE applications benefits, working principles and awareness.	"I'm an optimist, I think people felt informed. […] I think it... I think the presentation from... I don't remember the names of the people from the [research institute] but I think people understood what they were talking about".
Moral consequential and pragmatic disposition	Companies displaying environmental and societal values have a better reputation.	"I guess again for the customers, it's more that wider aspect that they can show that they are taking their environmental responsibility seriously, and they are driving down their impact on the environment. […] looking at individual projects probably doesn't really make a huge difference to the customer. It's when it's put in context with everything else and used as part of being able to demonstrate that it's not just greenwash[ing], that they are actually doing something, I think that's where the benefit is."
Moral procedural, structural, regulatory and risk perceptions	Safety concerns are alleviated if appropriate procedures, systems and regulations are in place.	"I'd be fine […] as long as it's sort of carefully regulated and it's actually manufactured safely."
Cognitive comprehensibility and taken-for-granted	The experience of current societal challenges led to perception of inevitability.	"We can't keep using them [resources] endlessly […] we can't keep on using them at the rate we are so anything we can do to recycle."

Connecting legitimacy categories	Nature of the connection	Illustrative quotes
Moral consequential, and taken-for-granted	Examples of CE applications may lead to replication.	"[…] to make that a completely circular system. if they can reach that goal […] The impact is of course very big, not only in the water system itself, but also in the… being a very inspirational example for other breweries to show that we can do this."

5 RESULTS 2: INTERVIEWS WITH MEMBERS OF THE PUBLIC

This chapter reported results from 12 interviews with members of the public in the UK (Case C). To support the evidence, illustrative quotes were referenced in the text using the interviewee' number. Some of the quotes were inserted in full in the text. The full list of quotes was provided in Table 25 in Appendix A.2.3. When two quotes in the same legitimacy sub-category came from the same interviewee, the same number was used and the quotes in the table were presented in the order these appear in the text.

5.1 Relative strength of legitimacy categories

Overall, interviewees mainly referred to cognitive legitimacy, followed by moral and pragmatic legitimacy and, regulatory legitimacy, which received the least attention (Figure 18 and Table 22). Within each legitimacy category, the sub-categories received a relatively different attention. Moral legitimacy was mainly characterised by a positive valuation of CE applications' impacts (consequential legitimacy), and a sound system (structural legitimacy) monitored with appropriate procedures (procedural legitimacy). Personal legitimacy was the least mentioned category of moral legitimacy. With regard to pragmatic legitimacy, perceptions mainly related to the benefits to a wide range of stakeholders and outreach strategies (exchange legitimacy), and the trustworthiness and reputation of adopting companies (dispositional legitimacy) whilst it referred the least to low involvement opportunities and expectation for information (influence and exchange legitimacy). Reference to cognitive comprehensibility and taken-for-granted legitimacy were relatively even. Comprehensibility legitimacy referred to the awareness and understanding of CE applications. Taken-for-granted legitimacy referred to taken-for-granted practices, and the replicability and inevitability of CE applications. Regulatory legitimacy received the least attention and referred to the role of the government and a low awareness of regulations.

Table 22 - Summary of legitimacy categories among the public

Moral Consequential	**Strong.** (+) Right thing to do, environmental and societal benefits. (+/-) Comparison with alternatives.
Moral Structural	**Moderate.** (+) Network, location and characteristics of CE applications, structural capacity of CE applications to ensure safety.
Moral Procedural	**Moderate.** (+) Procedures to ensure safety perceptions. (-) Lack of controls.
Moral Personal	**Low.** (+) Ambassador for outreach.
Cognitive Comprehensibility	**Strong.** (+) Logical, awareness and understanding of CE principles, association with common CE practices, outreach to increase understanding. (-) The 'CE' term is not current.
Cognitive Taken-for-granted	**Strong.** (+) Associated with taken-for-granted practices, replication, low negative perceptions.
Pragmatic Exchange	**Strong.** (+) Benefits for a wider range of stakeholders (+/-) Expectation for outreach strategies (-) Disadvantages
Pragmatic Influence	**Weak.** (+) Indirect influence (-) Low perceived shared decision-making
Pragmatic Dispositional	**Moderate.** (+) Reputation benefits for doing the right thing (-) Greenwashing
Regulatory	**Weak.** (+) Government role, confidence that regulations are in place. (-) Low awareness of regulations.

(+) sources that drive legitimacy; (-) sources that challenge and weakens legitimacy

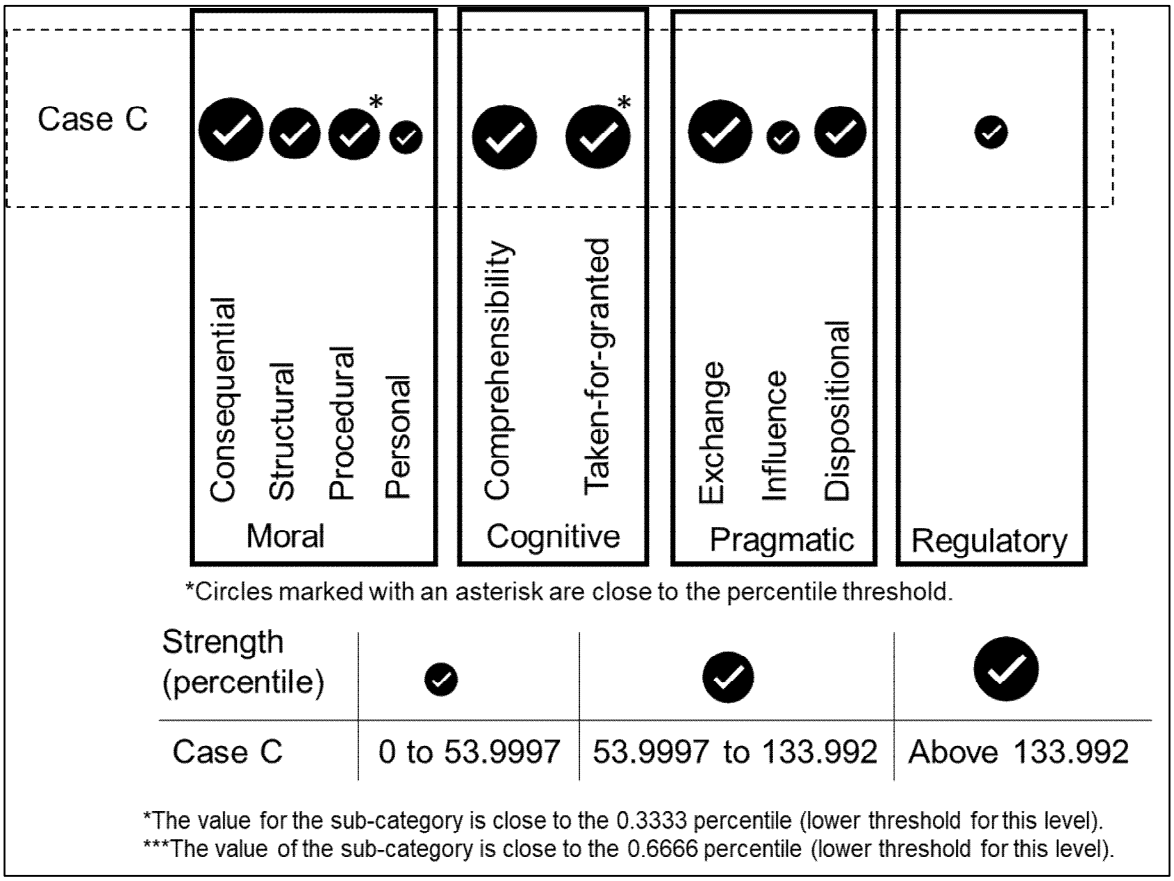


Figure 18 - Summary of legitimacy categories' levels and association with emerging themes

5.2 Moral Legitimacy

Interviewees referred to moral legitimacy in many ways. While moral consequential legitimacy referred to environmental and societal benefits provided by CE applications, procedural legitimacy provided insights on the procedures to ensure safety. Structural legitimacy was characterised by the network of stakeholders that was expected to gravitate around CE applications and the structural characteristics of such applications. Finally, personal legitimacy referred to expectations for ambassadors to talk about CE applications.

5.2.1 Consequential Legitimacy

CE applications were perceived as the thing 'that should be done' and the 'best thing to do'. Such perceptions were mainly motivated by the way resources are handled in the society [7]. CE applications were perceived to benefit the society and the environment over the short and long run. Perceived benefits included a more effective management of resources and waste reduction, the reduction of pollution and reliance on freshwater [9] and conventional fertilisers which was ultimately perceived to lessen the impact of human activities on the environment for future generations: *"[…] a better impact on the environment […] you are preventing the environment getting as bad as it could get*" [1]. However, minor concerns were raised regarding the potential negative effects of CE applications on the environment (e.g., building new infrastructure, polluting gas) [6]. Some interviewees could only see positive benefits for the society.

Perceptions that CE applications are the "best thing to do", or better than alternatives for producing water, energy, and nutrients, prompted some comparisons between CE applications and conventional practices. Comparisons were based on environmental outcomes, such as waste generation. For instance, CE applications were perceived a better option when compared to conventional energy production practices including fossil fuel burning, whilst producing energy using solar panels was considered a better option [9]. Moreover, the use of products from nutrients recovery to grow vegetables was perceived as a more natural option than using chemical and unnatural pesticides [2; 9].

5.2.2 Structural Legitimacy

Moral structural legitimacy was characterised by the network of stakeholders that was expected to take a steering wheel role in the development and quality control associated with CE applications, which included national and local governments (e.g., environment agency, water board) working together with industries and utility companies: "*Obviously people like the local authority, environmental agencies, national government, of course, to set a general plan, but certainly this would be more like a local authority and planning, it will be Environmental Agency*

[…] would be involved in [CE applications] and businesses as well, obviously, because they're the ones that will be producing them" [8]. Interviewees particularly expected from governments to provide financial support which was seen as essential at the starting phase of the implementation of CE applications [9; 11]. Moreover, interviewees expected CE applications to work at a local scale, for instance, situated close to the field on which fertilisers were spread and where the derived products were sold [3], and in an unpopulated area, which if not fulfilled could lead to perceptions that challenged the "greenness" of CE applications.

Another component of structural legitimacy referred to the perceived structural capacity of CE applications to treat wastewater efficiently and properly to provide safe outputs, such as treated wastewater and fertilisers. Interviewees expressed concerns over whether CE applications and derived products would be safe and free from any harmful substances [2]. Overall, interviewees trusted adopting companies to have appropriate systems and treatment in place to ensure safety [10; 9; 7].

5.2.3 Procedural Legitimacy

Risk and safety concerns were mainly associated with water reuse and nutrients recovery and included, for instance, risks of residual chemicals and bacteria in water [1], sludge, and fertilisers, and the potential impact of infrastructure change on the environment [7]. Moral procedural legitimacy mainly referred to procedures that were perceived to ensure safety perceptions which included checks, certifications, controls, tests, raw material tracing, and monitoring [12]: *"There would have to be controls over this, and presumably they're already our bodies, monitor the safety levels like they do with water has to be tested, and it has to be fit for human"* [8]. Although most interviewees thought that implementing companies would have appropriate procedures in place, one interviewee perceived that companies may not have control procedures [8].

5.2.4 Personal legitimacy

Finally, personal legitimacy was a small component of moral legitimacy and referred to the expectation to received information about CE applications from various actors which related to the outreach strategy described in Section 5.4.1 [6].

5.3 Cognitive Legitimacy

Cognitive legitimacy was characterised by comprehensibility and taken-for-granted legitimacy. Comprehensibility legitimacy referred to the awareness and understanding of CE applications, and associations of CE applications with common CE practices in the interviewees' daily live. Taken-for-granted legitimacy referred to interviewees associations of CE applications with taken-for-granted practices and perceived opportunities for replication.

5.3.1 Comprehensibility Legitimacy

Cognitive comprehensibility legitimacy was assigned by interviewees because CE applications were described as "making sense" and being "logical" [7]. The majority of interviewees had previous knowledge and understanding of the principles of the CE. However, it was also raised that the term "CE" was not of current use in the daily life of interviewees [3], and that the term "economy" prompted interviewees to think that they had to pay [5]. Although interviewees had a good understanding of the CE diagrams presented to them, it was perceived that education and outreach strategies (see pragmatic exchange legitimacy in Section Exchange Legitimacy 5.4.1) would increase the understanding and awareness of CE applications: *"I wouldn't have any concerns, but again I think you just need to educate the consumer. So they fully understand the process"* [4].

Interviewees associated CE applications with CE practices that were common in their daily lives. CE practices included interviewees' personal practices such as spreading manure on fields, buying beer from a circular brewery, setting up solar panels on the house's roof, and buying clothes from ethical shops [8]. These also

included practices in the localities of interviewees such as one town heating buildings with waste burning or a swimming pool being heated with the energy generated from a crematorium [5; 6]. Finally, CE applications were associated with the experience of current societal challenges related to the depletion of resources, and the global unsustainable production and pollution.

5.3.2 Taken-for-granted Legitimacy

Interviewees associated the CE concept and CE applications with natural processes (i.e., the CE is replicating what nature has done for many years) [7], already taken-for-granted practices, such as recycling, and known concepts, like sustainability, which classified CE applications in long-lasting or taken-for-granted frames. Moreover, interviewees mentioned that such CE applications have been running and happening for a long time with the mention of de facto CE [3; 12], including examples of water being recycled up to seven times in London [5] or vegetables irrigated with recycled water [3]. CE applications and the CE were perceived as inevitable, essential, and as the only way to go forward with regard to the current challenges and resource management practices: *"It [CE] is just essential because we are just using up all the planet's resources […] we have got to do it"* [6].

A second element associated with taken-for-granted legitimacy referred to interviewees perceptions that CE applications should be extended and replicated. When presented with a diagram of CE applications, interviewees perceived that recycled water could be reused for heating homes, irrigation, bathing, and washing, instead of being discharged into the sea [5]. More broadly, CE applications were seen as a pilot that could be replicated if successful: *"Every manufacturer and every system should be doing that and this will be a pilot that everybody can copy really"* [2]. Interviewees felt that people and companies have wastes that could be turned into resources [1]. Therefore, one of the impacts of interviewees' interaction with a diagram representing CE applications referred to the desire to see these replicated [4]. Finally, the taken-for-grantedness of CE applications was reinforced by the absence of negative perceptions.

5.4 Pragmatic Legitimacy

Interviewees referred to pragmatic legitimacy in many ways. While pragmatic exchange legitimacy referred to the perceived benefits that CE applications provide to a wide range of stakeholders and expected outreach strategies, dispositional legitimacy touched upon the trustworthiness (or lack of) and reputation of adopting companies. Influence legitimacy revealed low involvement opportunities associated with CE applications.

5.4.1 Exchange Legitimacy

Among the public, exchange legitimacy mainly referred to CE applications benefits to various stakeholders and the need for outreach strategies to a lesser extent. CE applications were perceived to benefit local communities, farmers, consumers, and adopting companies. Perceived benefits for local communities included employment opportunities [5], although a CE may mean that less products are created which was perceived to hamper employment, as well as a reduction in local taxes due to the reduction of waste disposal and pollution [9]. However, there were perceptions that CE applications may not be beneficial (e.g., in areas with abundant fresh water) [3] or could not make a difference in communities' daily lives in terms of energy since, for instance, the local community would be supplied with energy whether it is recovered energy or energy from conventional processes [1]. Concerns were raised regarding the smell and noise that CE applications could generate with regard to local communities and consumers visiting the distillery [2]. Perceived benefits for farmers included the provision of fertilisers, such as sludge [5], although farmers willingness to use such fertilisers was questioned. Some interviewees perceived that the public would only benefit from CE applications indirectly, with global benefits such as, lower levels of water and air pollution, and carbon footprint for contemporary and future generations at a societal scale [10].

With regard to consumers, the cost of derived products (i.e., whisky) was a widely discussed topic. Whilst some interviewees thought that the products would be cheaper due to a reduction of production costs [3], others expected the opposite

[7], and some were undecisive and their opinion would depend on the cost. Few interviewees did not attribute any benefit to consumers, whilst some perceived CE applications as a “unique benefit” for consumers. There were concerns about the taste of the whisky as well as indications that the taste may be more important than the CE aspect associated with the product and the company [9, 12]. With regard to benefits for adopting companies, these were mainly economic. The benefits included a lower disposal cost, a decreased energy purchase, and the creation of an income from fertilisers sale, and related to the effective management of resources [1]. However, few interviewees expressed concerns that the transaction costs for transporting sludge could outweigh the financial benefits of being circular.

Another element of exchange legitimacy related to the outreach strategies. Although interviewees had a clear idea of CE applications benefits, some expressed a need for more information: *“[…] because people are very suspicious, aren’t they […] so I think it needs quite a lot of education around it”* [6]. Interviewees expected to receive accessible information about the CE applications impacts on the society and the environment, advantages and disadvantages when compared with conventional applications, and working principles [7]. Interviewees expected to receive information from trusted actors such as local schools, supermarkets, local governments, soil associations, charities, distilleries, and the media, as such actors were believed to bridge the gap between the public and adopting companies [4], and may be more trusted than politicians.

5.4.2 Influence Legitimacy

When interviewees were asked about how they could influence the development of CE applications, perceptions ranged from no awareness of how to influence [8], to consultation and involvement. Modes of influence were mainly indirect and only a few interviewees felt that they could directly influence the development and operation of CE applications. Indirect influence included perceptions that local communities could vote or talk with local representatives, politicians, and

community members: *"When it comes to voting for any […] policy that does make it [CE applications] an important part of their policies"* [9]. It was perceived that consumers could influence CE applications by purchasing products from adopting companies instead of traditional ones [1]. It was perceived that societal expectations would influence the uptake of CE applications. Finally, interviewees' perceptions of CE applications would improve if they were involved and consulted [2].

5.4.3 Dispositional Legitimacy

Dispositional legitimacy was based on perceptions that adopting organisations were trustworthy and had a good reputation because they act in an ethical and responsible manner towards the environment and the society [4]: *"I am supporting a company that is not having such a negative impact on society and on the environment and aren't being sort of wasteful, they are actually more considered ethical in their values"* [7]. Some interviewees were willing or are already paying more for ethical brands [7]. Adopting companies were perceived as forward thinking and displaying similar values to those of the interviewees. However, adopting companies were also associated with greenwashing activities by a minority of interviewees [8]: *"It does seem to be a rehash of the concept of green washing where companies tend to try assume green credentials for their activities"* [3]. Interviewees expected to see the whole supply chain of adopting companies to check for the non-environmental activities, the use of rare earth minerals, the sources of raw materials, the working conditions, and the costs, which could prevent greenwashing perceptions. Although companies' trustworthiness was questioned, CE applications were considered as environmentally friendly as long as the supply chain of CE applications was kept locally.

5.5 Regulatory Legitimacy

With regard to regulatory legitimacy, interviewees were unaware of regulations associated with the CE, but assumed that some regulations were in place to frame CE applications, especially within the regulatory context of the European

Union [8, 10]. When regulations were discussed, interviewees mainly referred to those related to food and agricultural systems given that CE applications were implemented within a distillery. Interviewees perceived that the government had an important role to play in encouraging CE applications by providing incentives or disincentives. Moreover, interviewees perceived CE applications as safe if appropriate regulations were followed and enforced by regulatory bodies: *"I would be fine as long as it was carefully regulated"* [7].

5.6 Linkages between legitimacy categories

The main linkages between legitimacy categories were presented in

Table 23.

Table 23 – Illustrative quotes showing the main links between legitimacy categories for public interviews

Connecting legitimacy categories	Nature of the connection	Illustrative quotes
Pragmatic exchange and cognitive comprehensibility	Outreach strategy to increase the understanding of CE applications benefits, working principles and awareness.	"You just need to educate the consumer so they fully understand the process […] you can explain things on packaging, you could explain things as a general advertising campaign […] it depends on […] unique product benefits this whiskey has." "I think more about the benefits […] I don't really know what happens currently […] what would be the benefits, not just for society and the environment."
Moral consequential and pragmatic disposition	Perceptions that companies displaying environmental and societal values have a better reputation.	"I'm so very proud of […] companies that make an effort and companies that [are] recognizing that the environment and the planet has any like any one of it." "The company […] will be less wasteful so they can have slightly higher places […] like as an ethical company."

Connecting legitimacy categories	Nature of the connection	Illustrative quotes
Regulatory and moral structural and procedural legitimacy	Perceptions of safety concerns depend on whether procedures, systems and regulations around CE applications are appropriate.	"I would be fine […] as long as it is sort of carefully regulated and it's actually manufactured safely." "There would be controls over this, and presumably they are already our bodies, monitor the safety levels like they do with water."
Cognitive comprehensibility and taken-for-granted	The experience of current societal challenges led to perceptions of inevitability.	"[…] it [CE] is just essential because we are just using up all the planet's resources […] we have got to do it." "We can't keep using them [resources] endlessly […] we can't keep on using them at the rate we are so anything we can do to recycle."

6 DISCUSSION

The aim of this thesis was to extend the prevalent conceptual perspective on legitimacy to CE applications relevant to the water sector, including water reuse, nutrients and energy recovery, and understand the legitimacy of CE applications through perceptions. Using the legitimacy typology introduced in Chapter 2, a qualitative research design was employed to interview stakeholders associated with three contemporary case studies and members of the public. Findings from Chapters 4 and 5 are summarised in four points. First, findings described perceptions associated with four legitimacy categories in a CE context. Second, findings highlighted that perceptions of CE applications in all three case studies were mostly associated with moral consequential and structural, cognitive and pragmatic exchange and dispositional legitimacy. Third, the variation of levels in legitimacy categories created legitimacy landscapes that were specific to each of the cases in stakeholders' interviews. Finally, findings showed linkages between legitimacy categories.

6.1 Legitimacy: A complementary view to an acceptance perspective in the CE literature

This research shows that perceptions of CE applications relate to a wide range of legitimacy categories: perceptions that relate to societal and environmental benefits (moral legitimacy), daily life and taken-for-granted routines (cognitive legitimacy), self-interested benefits, education, and involvement (pragmatic legitimacy) as well as regulations (regulatory legitimacy). For instance, the local community contributed to the emergence of CE applications in Case A. Instead of the local community being asked to accept CE applications, they were proponents who contributed to the legitimation of CE applications. These findings add to the emerging body of research that indicates wider benefits to adopting a broader legitimacy perspective when compared to an acceptance one that partly relies on the deficit model, defined as the passive acquiescence to specialists' knowledge (Harris-Lovett et al., 2015). It shows that perceptions of CE applications consider, for instance, dispositional, procedural, influence and

personal legitimacy (Harris-Lovett et al., 2015), which are absent in the passive acceptance of specialists' opinions. Nonetheless, an acceptance perspective remains highly relevant to understanding the factors that lead to acceptance and is still widely used in the literature looking at the CE.

The seminal work that introduced legitimacy as a complementary view to an acceptance perspective focuses on the deficit model that an acceptance perspective promotes (Harris-Lovett et al., 2015). The present work goes further and proposes that legitimacy is a complementary view to an overall acceptance perspective. Findings reveal perceptions of CE applications that relate to four legitimacy categories that co-exist for each case and interviewee. Therefore, perceptions of CE applications may not always satisfy a binary outcome presented in an acceptance perspective stating that CE applications are perceived as accepted or not if a given factor is present. This means that there may be as many outcomes as there are perceptions of CE applications. Legitimacy could, therefore, be seen as a prism breaking acceptance into a more comprehensive, fine grained and nuanced range of perceptions. This does not imply, however, that some individuals cannot solely accept CE applications.

Not only does legitimacy break acceptance into many perceptions, but it also shows that some perceptions are stronger than others. Findings from this thesis provide for the first time, empirical evidence of levels of perceptions associated with four legitimacy categories of multiple CE applications in the water sector. Perceptions mainly referred to moral consequential and structural, cognitive and pragmatic exchange and dispositional legitimacy. Moral legitimacy mainly referred to perceptions that CE applications provide environmental and societal benefits and hence are the right thing to do and are managed by strong networks. Cognitive legitimacy mainly related to perceptions that CE applications are understood, inevitable, replicable, and connected with daily life and taken-for-granted practices. Pragmatic legitimacy mainly described perceptions that CE applications enhance reputation and provide a range of benefits.

There is value in uncovering the relative levels of legitimacy categories associated with perceptions of CE applications. The presence of levels highlights that one may perceive CE applications as legitimate overall on the basis of certain elements of legitimacy being strong while some others are weaker. Legitimacy associated with CE applications may rely on a coherent combination of weak and stronger perceptions associated with one or more legitimacy categories that co-exist and balance each other. These findings provide a more nuanced view to an acceptance perspective adopted in the CE literature stating that a given factor drives or hinders acceptance or uptake. This research thus adds to studies looking to identify the most pressing or the most cited drivers and barriers (Kevin van Langen et al., 2021; Mainardis et al., 2022). A similar observation was found in the CE literature employing Institutional Theory. For instance, income from recycling for low-income residents in China was normatively valued while the implementation of CE regulations at a local level was challenged (Ranta et al., 2018). This showed that normative legitimacy was the most influential legitimacy category when compared to regulatory legitimacy whilst further arguing for a holistic combination of all legitimacy categories (Ranta et al., 2018).

6.2 An understanding of factors introduced in the CE literature

Major findings from this research bring a deeper understanding of factors that hinder the acceptance and uptake of CE applications. Overall, findings show that public and stakeholders' perceptions associated with legitimacy were positive and that CE applications were perceived as inevitable and replicable (cognitive legitimacy), socially expected and embedded in strong networks of stakeholders convinced of the rightness of CE applications (moral legitimacy). These findings challenge evidence that public and stakeholders' perceptions are a critical barrier (Bischel et al. 2012; Mainardis et al. 2022) and, more specifically, that factors such as 'hesitant company culture' (Govindan & Hasanagic, 2018; Kirchherr et al., 2018; Lee & Jepson, 2020; Salminen et al., 2021), 'resistance to change' (Kevin van Langen et al., 2021) and a 'lack of consumer interest' (Kevin van Langen et al., 2021; Wurster & Schulze, 2020) hinder a CE.

Whilst this may indicate a shift in urgency to adopt CE applications, findings are nuanced with perceptions of a small proportion of members of the public who associated CE applications with greenwashing. These findings are also nuanced by interviewees witnessing resistance in cases' stakeholders who are not convinced that circular applications are more beneficial than linear applications, do not acknowledge lessons learnt from experienced stakeholders, and are reluctant to learning new and complex ways to design CE applications. Therefore, these findings may add to the understanding of why a 'hesitant company culture' prevails. Moreover, by pointing out weaker aspects of legitimacy such as a lack of outreach strategies and regulations, this work pinpoints what aspects of the overarching umbrella of public and stakeholders' perceptions may limit the uptake of CE applications.

Findings from this study endorse factors that drive acceptance, such as 'environmental awareness' (Lee & Jepson, 2020) and hinder support like 'institutions' (de Jesus & Mendonça, 2018; Kakwani & Kalbar, 2020) by showing that stakeholders and the public perceive CE applications as the right thing to do because it provides environmental benefits on the one hand, and a lack of CE regulations and policies on the other hand. Finally, the identification of perceptions associated with four legitimacy categories provides a holistic understanding of factors that are 'societal-based' and 'cultural-based' which are often limited to the willingness to engage, awareness, knowledge, acceptance, and personal benefits in the CE literature (de Jesus & Mendonça, 2018; Kakwani & Kalbar, 2020; Kirchherr et al., 2018; Mondal et al., 2023; Singhal et al., 2019). Not only does this work unpack societal-based factors, but it also explains why these factors are critical or why perceptions are the way they are. Cultural-based factors, for instance, are found critical in this study because they generate ideas of inevitability and willingness to replicate, which can ultimately drive the uptake of CE applications.

6.3 Legitimacy landscapes and legitimation pathways

An important finding emerging from stakeholders' interviews is the role of the context in determining the legitimacy landscape of each case (i.e., combination of perceptions associated with legitimacy at different levels). Perceptions associated with contextual elements in Case A mainly referred to the experience of a long-term drought and need for water, a strong outreach and involvement strategy orchestrated by a powerful network, and the prevalence of similar systems, which built cognitive, pragmatic exchange, and structural legitimacy. Case B presented a more nuanced legitimacy landscape with relatively balanced categories and was characterised by reputational benefits, the government strategy, and the contextual expectation for aesthetic characteristics for the applications at the visitor centre, which built moral structural, pragmatic exchange and dispositional, and cognitive taken-for-granted legitimacy. Perceptions associated with Case C emphasised a strong reputation, societal expectation and storytelling for CE applications, as well as societal and environmental benefits and a strong sector strategy with the associated network and prevalence of CE applications, which built pragmatic dispositional, moral structural and consequential, and cognitive taken-for-granted legitimacy. The literature looking at legitimacy of environmental technologies identifies that perceptions of legitimacy are culturally specific (Harris-Lovett et al., 2015; Rohe & Chlebna, 2021) and vary in strength depending on the context (Rohe & Chlebna, 2021). For instance, the strength of pragmatic exchange and moral procedural legitimacy is context specific in a case of wind energy technology (Rohe & Chlebna, 2021). However, such studies do not reflect on the broader Legitimacy Theory and on theoretical implications for the legitimation processes or legitimation pathways.

Although the present research looks at 'snapshots' of aggregated perceptions at the scale of a case study, it is possible to reflect on studies that theorise legitimation pathways using a legitimacy-as-perception perspective at an individual scale in organisational studies (Bitektine, 2011). The presence of legitimacy categories that co-exist at different levels in this study highlights that

there may not be one linear and ideal legitimation pathway. The literature on organisational legitimacy defines a linear and ideal pathway as one assesses an organisation based on the sub-categories of moral legitimacy to classify it as familiar and reach cognitive legitimacy, which automatically stops the assessment (Bitektine, 2011). If cognitive legitimacy is not reached, the assessment continues to evaluate if the organisation is beneficial for individual actors (pragmatic legitimacy) and the society (moral legitimacy). This leads to the active support or sanction of the organisation, which ultimately prompts it to actively comply with societal norms and rules (moral and regulatory legitimacy). In other words, one category comes after another in a linear fashion. Similar observations have been made in the legitimacy-as-process literature, where one or two legitimacy categories are built at each of the legitimation stages in a linear fashion (Johnson et al., 2006).

In the context of CE applications in this study, a non-linear pathway reflects a more complex landscape of legitimacy categories that co-exist at the same time and at different levels, meaning that one single category may not come or be built after another in a linear and systematic sequence. Whilst it has been argued that the legitimation process using a legitimacy-as-process perspective may be non-linear and that the sequence may be iterative (Laïfi & Josserand, 2016), the present research shows that legitimacy-as-perception may be non-linear and iterative, and advances the understanding of legitimation processes using a legitimacy-as-process and legitimacy-as-perception. It shows that a legitimation process may be more flexible and complex than originally theorised. Rather than looking at a sequence of individual and discreet legitimacy categories, legitimation may be studied as complex landscapes of multiple legitimacy categories at different levels that transform over time.

Results could indicate that at a given point in time, specific levels of legitimacy categories are needed, while at another point in time, different levels of legitimacy categories are required, meaning that across the overall legitimation pathway, all categories and levels may be represented in an iterative and non-linear manner. What is legitimate may be delegitimised promptly in response to a changing

environment or context (Bergek et al., 2008; Markard et al., 2016). Therefore, there are benefits to be drawn from iterative legitimation processes that can flexibly adapt to changing circumstances and agendas (Laïfi & Josserand, 2016). Showing a greater range of legitimacy categories at different levels means that there may be more opportunities, at each stage, to influence the legitimation process 'as we go'. Finally, findings that show levels of legitimacy also suggest that it may not be essential to address all legitimacy categories of a framework at one point in time to establish the legitimacy of CE applications, which challenges that one may develop all the legitimacy categories of a framework in the literature looking at the legitimacy of water reuse (Harris-Lovett et al., 2015).

In the legitimacy literature, a legitimacy pathway using a legitimacy-as-perception and legitimacy-as-process perspective suggests that cognitive legitimacy may be the highest form of legitimacy since it is self-sustaining and profound (Suchman, 1995), and the judgment about a technology or an organisation stops if they are classified as being part of a legitimate group without going through the judgment of whether they are beneficial (Bitektine, 2011). The literature on legitimacy-as-property also stresses the importance of covering all legitimacy categories of the portfolio if CE applications are to reach a taken-for-granted level of legitimacy (Harris-Lovett et al., 2015). Because perceptions of inevitability (cognitive legitimacy), rightness and societal and environmental benefits (moral legitimacy) co-existed at different levels in the findings, further questions are warranted. Specifically, questions related to whether cognitive taken-for-granted legitimacy is the ultimate goal or if outcomes such as perceptions that CE applications provide societal and environmental benefits and hence are the right thing to do may be enough to generate overall positive perceptions.

6.4 A perceptual perspective looking at the legitimacy of multiple CE applications

Although this study used elements of the three legitimacy perspectives, namely, legitimacy-as-property, legitimacy-as-process and legitimacy-as-perception, the latter was the predominant perspective. The literature looking at the legitimacy of

water reuse has mainly relied on a legitimacy-as-property (Harris-Lovett et al., 2015), and legitimacy-as-process perspectives (Binz et al., 2016). This study provides a less processual and more perceptual and static perspective on legitimacy. Using a legitimacy-as-perception perspective allows to reflect on how properties of legitimacy and actions are actually perceived rather than stated as facts, which could not have been observed with the two other perspectives. For instance, results revealed a perceived lack of information in Case A despite a strong outreach strategy and a lack of conviction of CE applications' benefits in Case B, although examples of such applications have been proven to work and be beneficial before. Moreover, it brings a richer and more complete picture of the legitimacy associated with CE applications that relies on aggregated perceptions of different stakeholders rather than solely on the actions performed.

6.5 A legitimacy framework as a diagnostic tool

While analysing perceptions of CE applications using the framework of four categories is essential to unpack the legitimacy landscape of a CE application, there may not be a need to develop and address all four categories for every single CE application in practice and the value of building other legitimacy categories needs to be carefully considered. Previous literature argued that all the categories of a legitimacy portfolio need to be covered if CE applications are to reach a taken-for-granted state, and weaker categories were framed as 'gaps' (Harris-Lovett et al. 2015). The present research argues that what was framed as 'gaps' may represent opportunities, and it may make sense to develop those categories, whilst in other contexts, it may be irrelevant. For instance, when alternative technologies may be more appropriate (Harris-Lovett et al. 2015), as it was also found in the present work, it may not make sense to develop any legitimacy category at all, and in other circumstances in which the general public may not directly benefit from CE applications for instance, it may make sense to focus on feelings that CE applications are the right thing to do because these bring environmental and societal benefits (moral) and inevitable (cognitive) rather than demonstrating how the public can directly benefit from such applications (pragmatic).

The exact circumstances under which weaker categories may be developed or not remain unclear. This warrants future research. One particularly fruitful integrative framework to explore in a CE context, proposes to look at the nature of legitimacy (e.g., moral, cognitive, pragmatic, regulatory), the object of legitimacy, the context and the audience (Laïfi & Josserand, 2016, p. 2350). By treating legitimation as an iterative and non-linear process in practice, this framework could adapt to contextual and audience-specific events as they arise or what is framed as an “opportunistic bricolage” (Laïfi & Josserand, 2016).

6.6 Expanding the interpretation of legitimacy categories

This study expands the interpretation of legitimacy categories by highlighting elements of legitimacy that are expressed in relation to CE applications in the cases, but that were not explicitly explained in previous frameworks established in the literature looking at the legitimacy of organisations and environmental technologies. Firstly, the findings in this study expand the interpretation of consequential legitimacy by showing the breadth of socially valued outcomes (Suchman, 1995). These include perceptions that CE applications are the right thing to do because they provide societal and environmental benefits. Such findings may not have been identified within frameworks adopting narrower definitions of consequential legitimacy in water reuse studies, including a consistent provision of quality water as an outcome (Harris-Lovett et al., 2015). Whilst the identification of environmental benefits aligns with environmental technologies studies that report perceived environmental impacts, mainly through surveys (Dehler-Holland, Okoh, and Keles 2022; Rohe and Chlebna 2021), this work provides an in-depth understanding of perceptions of environmental benefits associated with moral legitimacy.

Second, perceptions associated with moral structural legitimacy refer to the networks of stakeholders and sector’s strategy that build the structural capacity to perform ‘CE applications’ with, for instance, skilled and knowledgeable stakeholders. In the literature looking at environmental technologies, ‘normative networks’ are used to build moral and regulatory legitimacy by providing

evaluation and certification (Binz et al., 2016), ‘branding utility networks’ build pragmatic legitimacy (Harris-Lovett et al., 2015) and ‘alliances’ between stakeholders improve the legitimacy of bioplastic technologies by expanding the markets in which they are introduced, by including regulators that can lobby for new regulations, and by partnering with famous partners that can promote CE applications (Kishna et al., 2017). Whilst the present research identifies all these elements, it also recognises that heterogeneous networks of stakeholders who are technically skilled and knowledgeable about local issues and sector strategies are key to ensuring the structural capacity to design and run CE applications.

Third, cognitive taken-for-granted legitimacy is associated with perceptions that CE applications should be replicated. Whilst the original definition states that prevalence is a measure of taken-for-grantedness (Suchman, 1995), perceptions that CE applications should be replicated highlight future directions of perceptions that may not be identified with a static view of what is prevalent at a given point in time. This aligns with environmental technologies studies that identify perceptions that onshore wind energy should be expanded (Rohe & Chlebna, 2021). Finally, safety was associated with moral structural and procedural legitimacy in the typology introduced in Section 0 (i.e., sound system and safety procedures) based on the interpretation of studies looking at the legitimacy of water reuse (Harris-Lovett et al., 2015). Findings from this study show that safety perceptions were also associated with perceptions that appropriate regulations frame CE applications and hence with regulatory legitimacy, which is not mentioned in the literature looking at the legitimacy of environmental technologies employing regulatory legitimacy (Jaber & Oftedal, 2020).

6.7 Differences between public and stakeholders' interviews

Findings showed that stakeholders’ and public’s perceptions of CE applications are relatively similar and only mirror minor differences. Overall, the strengths of legitimacy categories were relatively similar across these two groups: moral consequential (environmental and societal benefits) and structural (network and

structural characteristics), cognitive (connection with daily life, inevitability), pragmatic exchange (benefits, low outreach strategies) and dispositional (reputation) legitimacy were mentioned the most. Differences mainly lied in pragmatic, cognitive, and regulatory legitimacy themes. There was a perceived lack of communication, education, and involvement among the public whilst the three cases are planning in Cases B and C, or already carrying out outreach strategies in Case A. The public referred to cognitive comprehensibility by connecting CE applications with daily life activities (e.g., recycling, spreading manure), whilst stakeholders in Cases B and C refer to the prevalence of CE and sustainable activities at a sectoral scale. Whilst the public tended to think that regulations are in place to regulate CE applications and ensure public safety, stakeholders reported a lack of regulations that applies to the CE. Finally, negative risk perceptions related to human health were slightly higher in public interviews than among stakeholders. With regard to stakeholders' interviews, one stakeholder highlighted that farmers may be the hardest stakeholders to convince due to the perceived fear of contamination of products derived from sludge.

These minor differences have several implications. These challenge studies that hypothesise and show early indications of diverging assessments by different stakeholders (e.g., public and professional community) about the legitimacy of CE applications such as water reuse (Harris-Lovett et al., 2015) and biogas (Markard et al., 2016). Findings from this thesis show early indications that the public and stakeholders may look in the same direction to form a common perception of CE applications. This is not to say that a diversity of perspectives is not recognised. Practically, minor differences help identify elements that will need to be accounted for in outreach strategies. To foster a common perception further, CE practitioners may tailor information, engagement, and involvement to the specific needs of the public and farmers. Finally, these differences warrant future research employing comparative analyses to provide an in-depth understanding of inter-stakeholders' differences.

Moreover, looking at perceptions of both the public and case studies' stakeholders, and identifying similarities and differences extend the

understanding of the legitimacy and legitimation of water reuse that was exclusively studied among the public in previous studies (Binz et al., 2016; Harris-Lovett et al., 2015). The present study unravelled perceived challenges, such as a lack of skilled practitioners to design and manage CE applications, argued benefits attached to them, and a lack of regulations. This likely would not have been revealed if the public was the only interviewee type considered.

Methodological choices prompt a reflection on the use of real-world case studies for stakeholders' interviews and a hypothetical case for public interviews, and their impacts on the findings. It was expected that legitimacy categories that relate to involvement (pragmatic influence), personal benefits (pragmatic exchange) as well as experiences in the daily life (cognitive comprehensibility) may be affected by the nature of the case studies. Whilst no interaction with CE applications was available to the public, they reported a clear understanding of how they could benefit from CE applications and were able to connect these with their daily lives. These findings are comparable with those of stakeholders' interviews. Conversely, the use of a hypothetical case could partly explain why the public perceived a lack of communication and involvement with regard to CE applications when compared to stakeholders who detailed outreach and involvement strategies (especially for Case A). Real-world case studies used for this research were at an early stage, and some stakeholders had similar levels of interaction with CE applications to those of the public at the time of the interviews. Differences around outreach and involvement strategies are expected to grow further as real-world case studies mature and outreach and involvement strategies develop.

6.8 Growing perceptions of legitimacy categories

Findings showed early indications that moral consequential, pragmatic dispositional, cognitive taken-for-granted and regulatory legitimacy are emerging categories of relative significance. Whilst there is a growing societal expectation for positive environmental outcomes, CE applications are perceived as inevitable for the future and replicable, and it is perceived that regulations supporting the

CE start emerging. By looking at contemporary cases, this research provides an alternative view to the historical methodology employed in studies looking at the legitimacy of environmental technologies (Dehler-Holland, Okoh, and Keles 2022; Harris-Lovett et al. 2015; Markard, Wirth, and Truffer 2016). It indicates future trends and tentative directions for legitimacy; these categories will likely be driving perceptions and adoption of CE applications in the future. Similar results are found in studies looking at the legitimacy of contemporary cases of environmental technologies (Jaber & Oftedal, 2020; Lempiälä et al., 2019). For instance, employees' perceptions of renewable energy activities see such activities as the way toward future opportunities (normative legitimacy) (Jaber & Oftedal, 2020). Moreover, it is shown that introducing the energy source as an inherent component of the future energy system is essential at the start of the legitimation process for various actors to associate solar technologies with modernisation and progress (normative and cognitive legitimacy) (Lempiälä et al., 2019). Future research may focus on understanding those trends further by, for instance, looking at how and if growing legitimacy categories can accelerate the growth of legitimation processes. Recommendations in Chapter 7 are formulated based on these trends that can directly influence the development of the cases and of the CE more broadly by, for instance, connecting CE applications with the wider societal and environmental picture in outreach strategies.

7 CONCLUSION

This concluding chapter summarises key findings and outlines how the thesis addresses the aim and objectives. It then describes the contribution to the CE literature and the literature on legitimacy, reflects on theoretical and methodology choices and highlights limitations that warrant further research needs.

7.1 Summary of key research findings and how they address the objective of the thesis

The present research aimed to extend the prevalent conceptual perspective on legitimacy to understand the legitimacy of water-centric CE applications. Through an embedded case study design, a qualitative research approach employing semi-structured interviews was used to explore legitimacy perceptions of CE applications among stakeholders from three case studies and members of the public. The findings contributed to filling several research gaps identified in the CE literature and the literature looking at the legitimacy of organisations and environmental technologies. Knowledge gaps related to (1) a lack of in-depth and nuanced understanding of societal-based and cultural-based factors in the CE literature, (2) a limited understanding of whether CE applications can be perceived as legitimate, (3) a limited understanding of whether contemporary cases of water-centric CE applications can be perceived as legitimate or if legitimacy can only be acknowledged in retrospect in historical studies, and (4) a limited understanding of whether legitimacy perceptions apply beyond individual CE applications to a combination of water reuse, nutrients and energy recovery among a wide range of stakeholders.

Objectives 1 and 2: To identify what aspects of legitimacy are utilised by stakeholders and the public in describing their perceptions of real-world CE applications across different case studies and hypothetical CE applications, respectively.

Using insights from semi-structured interviews with stakeholders from three case studies and members of the public, this research identified the main perceptions

associated with each of the four legitimacy categories. Stakeholders' perceptions of CE applications were mainly associated with moral consequential and structural, cognitive, and pragmatic exchange and dispositional legitimacy among stakeholders. Legitimacy landscapes varied across the three cases and were therefore context specific. Perceptions in Case A mainly referred to the experience of a long-term drought and the need for water, a strong outreach and involvement strategy orchestrated by a powerful network, and the prevalence of similar environmental initiatives, which built cognitive, pragmatic exchange and influence, and structural legitimacy. Case B presented a nuanced legitimacy landscape and displayed perceptions associated with the reputation of the adopting company, the government strategy, the contextual expectation for aesthetic characteristics for CE applications at the visitor centre, which built moral structural, pragmatic exchange and dispositional, and cognitive taken-for-granted legitimacy. Perceptions in Case C mainly referred to a strong reputation, environmental and societal benefits as the right thing to do, and a strong sector strategy with the associated network and prevalence of CE applications, which built pragmatic dispositional, moral consequential and structural, and cognitive taken-for-granted legitimacy. Public perceptions displayed higher perceptions associated with the prevalence of CE practices, the inevitability and comprehensibility of CE applications, environmental benefits as the right thing to do, and the benefits to a wide range of stakeholders, which referred to moral consequential, cognitive and pragmatic exchange legitimacy. The public, however, mentioned a lack of communication and involvement, and a low awareness of regulations, which referred to pragmatic exchange and influence, and regulatory legitimacy.

Objective 3: To understand and explain the extent to which one connects local CE applications with other CE applications.

The effect of stakeholders' interactions with local CE applications on perceptions of other CE applications referred to cognitive taken-for-granted legitimacy. It referred to perceptions that CE applications should be replicated. Moreover, the CE concept may actually impact perceptions of local CE applications since

stakeholders and the public associated familiar and taken-for-granted CE practices such as waste recycling or the prevalence of the CE in the sector, with local applications.

Objective 4: To use the acquired knowledge to reflect on general and CE-specific aspects of legitimation processes and to provide recommendations that may advance the legitimation of CE applications.

This objective was not tested in the research, but it was addressed in two ways. First, the findings of this research informed the theory on legitimacy-as-perception and legitimacy-as-process or legitimation. As detailed in Section 6.3, complex landscapes of legitimacy categories that co-exist at the same indicate that legitimacy pathways may be non-linear and iterative (Laïfi & Josserand, 2016), and may not operate following a systematic sequence. Moreover, findings show early indications that moral consequential, pragmatic dispositional, cognitive taken-for-granted and regulatory legitimacy are growing categories. As detailed in Section 6.8, these categories may represent future trends and tentative directions for the legitimation process for CE applications.

Second, the identification of levels of legitimacy helped to provide recommendations that foster strong and growing legitimacy categories and build weaker categories. Recommendations present a list of concrete actions, or Institutional Works (see Section 2.3), that are designed to promote legitimation. Recommendations are outlined for outreach managers, governments, and regulators, as well as adopting companies. Practically, findings from this research equip stakeholders inclined to adopt CE applications with an understanding of the key elements that may need to be accounted for. The legitimacy typology (see Section 0) can be utilised as a diagnostic tool to identify areas that need to be addressed to foster the legitimation of CE applications. However, it is not assumed that there is a need to increase every legitimacy category. Developing some legitimacy categories may be a strategic decision that depends on the targeted audience and the most salient contextual aspects associated with CE applications. As legitimation is considered iterative and flexible in practice (Laïfi

& Josserand, 2016) and may not require building all legitimacy categories, CE stakeholders may choose to follow any of the recommendations presented below.

Recommendations to outreach managers refer to building pragmatic exchange and influence legitimacy, as well as cognitive comprehensibility legitimacy through outreach and involvement strategies. Stakeholders' perceptions are often cited as a barrier to the development of the CE (Bischel et al., 2012; Mainardis et al., 2022). Trained outreach managers may not automatically assume that all perceptions constitute a barrier, but they may rather investigate what specific elements are particularly challenging and what are the ones they can build on. They may also acknowledge that the CE is not a familiar term, although the public is likely to grasp its key principles. In some cases, outreach strategies may be best segmented to reflect and address the level of knowledge, concern, and expectation of different groups of stakeholders. For instance, outreach to farmers may be conducted separately due to distrust in products recovered from wastewater.

Outreach managers may structure communication to reflect strong legitimacy categories. A communication based on moral legitimacy may introduce the CE as the right thing to do, connect the CE with societal challenges (e.g., climate change, resource scarcity), demonstrate how a CE can deliver environmental and societal benefits, and emphasise safety procedures and structurally sound CE applications. A communication based on cognitive legitimacy may provide diagrams or visuals, whilst using accessible language, and convey the inevitable need for CE applications. It may also connect the CE to everyday routines, like waste recycling and local CE initiatives. Since CE applications are not always located near communities (e.g., industrial locations), communicating personal benefits, which grows pragmatic legitimacy, may not be consistently needed. Finally, a low awareness of how to influence CE applications may be addressed by providing the public, local communities, and customers with concrete steps and actions to take part in decision-making processes. Whilst involvement strategies may not be essential to foster an overall legitimacy of CE applications, whether to pursue them may be decided based on the need for direct interactions

between CE applications and communities, and their geographical proximity. Overall, involvement strategies may identify synergies and interdependencies, foster a common vision about CE applications (Fulgenzi et al., 2020), promote the emergence of strong networks, and guarantee access to local information and needs (as shown in Case A).

Practically, outreach strategies can be approached in many ways. As it was seen as highly effective in Case A, workshops are recommended for the local community. Workshops can aim to inform, explain, answer questions and, most importantly, involve the local community in the decision-making for CE applications. For instance, locals can provide inputs like local information and needs, as well as expectations as to what are the best and desired ways to communicate and be involved with CE applications. In addition to workshops, another approach to outreach within the local community is to have a local, legitimate, and trusted person who acts as a link between locals and project managers, and involves and communicates with locals daily (e.g., collecting perceptions, inviting to workshops, informing). Moreover, an immersive experience could be used for customers of breweries and distilleries. Customers could be taken on tours to discover and be informed about CE applications onsite and how these interact with the products they consume. Such immersive experiences could also aim to address broader objectives, such as communicating societal and environmental benefits. As for the members of the public who may not be in direct contact with CE applications, social media campaigns may be more appropriate to provide information related to strong legitimacy categories.

Recommendations to regulators and governments refer to fostering the momentum of a growing regulatory legitimacy by promoting collaborations between CE practitioners and regulators. A way of approaching outreach with regulators is for CE practitioners to provide information based on their experience with CE applications for regulators to update or produce supporting regulations. An example of regulation that stakeholders thought should be in place for the CE is a staged regulation that adapts the threshold (e.g., water quality) to the stage

of a given CE application, moving from trial to project until it reaches the completion stage at which the highest threshold needs to be complied with. Moreover, additional work on the practical outcomes of end-of-waste regulations is needed to foster a change of paradigm from waste to resources since many activities, including waste handling, still require compliance with harsher regulations. A governance approach for the CE could include financial incentives for companies that adopted such applications, including help for initial investments, and disincentives such as penalties for companies that did not, as it was suggested by members of the public and seen in the literature looking at the agricultural transition (Boon et al., 2022). Finally, regulators may want to look at how regulations in related sectors (i.e., water, energy, food and agriculture sectors) can foster regulatory legitimacy, such as restrictions or bans on certain activities, which may encourage the uptake of CE applications as an alternative solution.

Recommendations for adopting and hesitant companies refer to pragmatic dispositional and moral structural legitimacy. Since CE applications are perceived to likely provide long-term financial and reputational benefits, prospecting companies may not assume that a CE equals financial loss. To prevent associations with greenwashing, companies may communicate about their circular and non-circular activities across the whole supply chain and carefully evidence any circular activity.

Finally, a hesitant company culture may be alleviated by training actors to gain in expertise, state-of-the-art techniques on the CE, confidence as to how to ‘tackle’ a CE and understand why CE applications are an essential part of any future development. Such trainings may be made available to employees by their organisations as part of an outreach strategy. When becoming CE practitioners, employees may also play a crucial role in communicating about CE applications to various stakeholders and may be trained to provide information in a manner that is engaging (Simis et al. 2016).

7.2 Contribution to the CE literature

This study contributes to the CE literature by providing a complementary view to an acceptance perspective. It provides a non-binary, comprehensive and nuanced understanding of perceptions towards CE applications in the cases.

First, an acceptance perspective satisfies a binary response to CE applications that either lead to acceptance or rejection. This study shows a comprehensive range of responses or perceptions associated with four legitimacy categories that co-exist. Legitimacy may therefore be seen as a prism that breaks acceptance into a comprehensive and almost infinite range of perceptions. Moreover, a wide range of perceptions associated with four legitimacy categories included for instance, perceived opportunities for communities to be involved in decision-making processes. These findings add to the emerging body of research that indicates wider benefits to adopting a legitimacy perspective in a CE context since perceptions go beyond the deficit model (i.e., passive acceptance of experts' knowledge) (Harris-Lovett et al., 2015).

There is value in uncovering a nuanced perspective based on relative levels of legitimacy categories. Firstly, one's overall perception that CE applications are legitimate may be based on certain elements of legitimacy being strongly perceived, whilst some others may be weaker. Secondly, the presence of levels showed what legitimacy categories were the most important in the judgment of CE applications in the case studies and may be relevant beyond water-centric CE applications. Those were mostly related to moral consequential and structural, cognitive, and pragmatic exchange and dispositional cognitive legitimacy. These findings thus address the knowledge gap enquiring whether CE applications can be perceived as legitimate.

Finally, evidence of a wide range of perceptions unpacks societal-based and cultural-based factors provided by an acceptance perspective. Such factors are underexplored in the CE literature and are often limited to awareness, knowledge, acceptance, personal benefits, or the willingness to engage (Kakwani & Kalbar, 2020; Kirchherr et al., 2018; Laurenti et al., 2018; Mondal et al., 2023). This study

provides an in-depth and holistic understanding of the elements that may compose societal and cultural-based factors.

7.3 Contribution to the Legitimacy literature

Studies looking at the legitimacy of environmental technologies do not reflect on the meaning of their findings for Legitimacy Theory. For the first time, the present research reflects on the theoretical implications of the findings in three ways. First, the findings challenge previous knowledge on legitimacy that considered the establishment of legitimacy as a binary outcome (Harris-Lovett et al., 2015) and added to the long-standing debate of the nature of legitimacy (i.e., binary or continuum) (Ashforth, 2019; Ashforth & Gibbs, 1990).

Second, this study provides complex landscapes of legitimacy categories co-existing at different levels based on a given context. Although legitimacy landscapes are ‘snapshots’ of aggregated legitimacy perceptions at a point in time and the scale of a case study, this research informs the current understanding on legitimation pathways. It shows that there may not be one ideal legitimation pathway, in which legitimacy categories come or are built one after another, as it is argued in studies that theorise legitimacy-as-perception (Bitektine, 2011) and legitimacy-as-process (Johnson et al., 2006). Legitimation may be non-linear, more flexible and complex than originally theorised. Legitimation may need to be studied as complex landscapes of multiples legitimacy categories at different levels that transform over time.

This could indicate that at a given point in time, specific levels of legitimacy may be needed while they may not be at a later or earlier stage, thus reflecting on the iterative nature of legitimacy (Laïfi & Josserand, 2016). Therefore, there may not be a need to develop all legitimacy categories of a given framework as it is argued in a water reuse context (Harris-Lovett et al., 2015). A legitimacy framework may be used as a diagnostic tool to identify the most salient contextual elements to develop.

Third, this study expands the interpretation of legitimacy categories in the context of water-centric CE applications by highlighting elements of moral, cognitive, and regulatory legitimacy that are not explicitly explained in previously established frameworks (Scott, 1995; Suchman, 1995). It provides additional information about the breadth of socially valued outcomes provided by CE applications, including environmental benefits (moral consequential). It also deepens the understanding of the characteristics of the networks, including skilled and local stakeholders that are key to design and run CE applications (moral structural). Finally, this study expands the understanding of taken-for-granted legitimacy with a temporal dimension that relates to perceptions that CE applications should be replicated in the future. These elements provide clarity to the understanding of legitimacy categories that can be employed to study perceptions of CE applications beyond water reuse, nutrients and energy recovery to environmental technologies.

7.4 Reflections on theoretical and methodological choices and future research

Whilst this work mainly employed legitimacy-as-perception that states that legitimacy first "resides in the eye of the beholder" (Ashforth & Gibbs, 1990, p. 177), it also used the legitimacy-as-property and legitimacy-as-process perspectives. Legitimacy-as-perception revealed a wide range of perceptions relevant to a CE context. The inclusion of perceptions of actions and strategies (legitimacy-as-process), and properties attributed to CE applications (legitimacy-as-property), provided a richer understanding of the legitimacy landscapes by explaining how a strategy led to a given property. For instance, stakeholders witnessed that outreach strategies generated perceptions that CE applications are beneficial (pragmatic legitimacy) and understood (cognitive legitimacy) in all three cases. Moreover, legitimacy-as-property emphasises that legitimacy varies in quantity (Suddaby et al., 2017), which allowed to reveal levels of legitimacy categories that were highly relevant in a CE context. Combining the three perspectives brought a more perceptual and subjective understanding of actors'

actions (legitimacy-as-process) and legitimacy categories (legitimacy-as-property).

Similarly, choosing a sociological approach to legitimacy over a normative one provided a perceptual understanding of legitimacy with regard to CE applications, whilst the understanding may lack the clarity of a normative approach based on whether legitimacy categories were actually 'matched' in practice. Future research may combine normative and sociological approaches to bridge perceptions of legitimacy categories and the normative 'match' of these categories in practice, as it was shown to be useful in the context of agricultural transition (Boon et al., 2022).

This study chose a legitimacy framework based on moral, cognitive, pragmatic, and regulatory categories over an input, throughput, and output framework (Scharpf, 1999; Schmidt, 2013). An input, throughput, and output framework tends to focus on regulatory and pragmatic aspects related to communication and engagement. Findings showed the importance of providing an in-depth understanding of perceptual, contextual, and deeply engrained aspects associated with moral and cultural-cognitive legitimacy, which were mostly associated with perceptions of CE applications in the cases. This may otherwise not have been captured using an input, throughput, and output framework. The thesis' findings showed that legitimacy cannot solely rely on the 'easy fix' of participatory and regulatory practices that an input, throughput and output framework tends to focus on.

Limitations to the research steams from constraints put on the NextGen and Ultimate projects. The two projects confined the range of case studies to water-centric CE applications in Europe. Exploring CE applications that are centred on other resources and in other sectors may help to validate the findings presented in this research and explore the transferability further.

The selection of stakeholders was constrained by the two projects and was limited to stakeholders who willingly took part in establishing CE applications within the case studies, although the pool of interviewees also included local

communities who were not directly involved in the case studies. A lack of access to some interviewees meant that the heads of cases B and C were not interviewed. It is expected that interviewing the heads of Cases B and C could have added contextual information on the cases. However, many interviewees were highly involved and knowledgeable about the case and its context, meaning that not interviewing the heads may not have had an impact on the results. Technology providers were in high proportion in the sample for Case B. This may explain why physical and structural characteristics (i.e., size, fit with the historic building, decentralised) of CE applications, presented in moral structural legitimacy, were an important and detailed feature for this case. Moreover, members of the community and communication stakeholders were overrepresented in Case A. This may explain why the communication and engagement aspects of cognitive comprehensibility and pragmatic exchange legitimacy was more referred to in Case A when compared to Cases B and C. Finally, a bias was introduced by interviewing only stakeholders who were part of the two European projects that funded the research. These stakeholders were ultimately likely to be convinced of the benefits of CE applications, have prior knowledge and understanding of environmental topics, and feel inherently positive towards such applications. If 'outside' stakeholders (e.g., investors) were included, there may have been less perceptions of stakeholder-specific, societal, and environmental benefits, more perceptions of greenwashing, and less technical knowledge, awareness, and understanding, which may have altered moral consequential and structural, pragmatic exchange and dispositional, and cognitive comprehensibility legitimacy.

As for the public, interviewees were selected based on a range of demographics, awareness of the CE and values. Among those contacted as part of the sampling strategy, interviewees who agreed and voluntarily took part in the interviews were likely to have pre-existing interests in environmental topics. This may explain the overall positive tone of the interviews' results. Positive results may, however, be nuanced by perceived negative impacts of CE applications on the environment (moral consequential legitimacy), safety, smell, and noise concerns (moral

procedural and pragmatic exchange legitimacy), as well as perceptions of greenwashing (pragmatic dispositional). Diving into the demographics, interviewees aged 50 years and more (and hence retired) were overrepresented when compared to those aged 34 years and less (and hence students). Interviewees' current circular practices and perceptions that CE applications should be implemented may be seen as surprising since many studies have shown that older people are less inclined to behavioural change than younger people, who seem more willing to move from a linear to a circular model (e.g., Ali and Choe, 2022; Neves and Marques, 2022). Again, these surprising results may be explained by the pre-existing environmental values of interviewees who took part in the interviews. Finally, a big proportion of interviewees had a university degree (80%). Since some studies have shown that people with higher education tend to express more support towards CE applications like water reuse (e.g., Garcia-Cuerva, Berglund and Binder, 2016), the overall positive perception of CE applications in this study may partly be explained by the sample. Future research could explore the legitimacy perceptions of opponents and perceptions of stakeholders embedded in sustainability-proof sectors.

Findings showed early indications of relatively more positive perceptions associated with energy recovery when compared to perceptions associated with water reuse and nutrients recovery. The unit of analysis of this work was a case study of multiple CE applications (water reuse, nutrients and energy recovery) (see case study methodology in Section 3.2). Therefore, the three types of CE applications could not be explicitly disentangled. Future research may explore differences in perceptions by conducting a cross-CE applications analysis and looking at whether perceptions of one CE application can support or hinder perceptions of other applications when placed together.

There are early indications of stakeholders' perceptions that customers' interaction with CE applications could act as an eye-opener and modify how one acts and behaves with regard to water and the environment. Whilst a legitimacy-as-perception perspective offers to look at perceptions, it can also look at behaviours and actions emerging from perceptions (Bitektine, 2011). An

interesting research avenue could look at what perceptions various stakeholders act upon.

This research presented a ‘snapshot’ of legitimacy perceptions towards contemporary cases of CE applications. While it provided an understanding of levels of legitimacy categories and showed growing moral consequential, cognitive taken-for-granted, pragmatic dispositional and regulatory legitimacy, future research may look at a longitudinal understanding of how legitimacy landscapes evolve over time to form legitimation pathways.

Evidence showed that regulatory legitimacy was the least referred to across all cases. This could be explained by three elements. First, although regulatory legitimacy was sometimes referred to by interviewees when asked questions associated with other legitimacy categories, a relatively limited number of questions (two for stakeholders’ interviews and three for public interviews) directly addressed regulatory legitimacy. Second, regulators only constituted a small proportion of the sample, whilst stakeholders such as members of the local community, technology providers and farmers had limited knowledge about policies and regulations. Less importantly, it is generally accepted that regulations for CE applications are limited, as it was also reported in the interviews, which may not have encouraged stakeholders to expand their argument on a regulatory front. However, it is important to acknowledge that a lack of mention for regulatory legitimacy may not necessarily mean that there is a lack of regulatory legitimacy in the cases. A lack of mention may rather mainly be explained by the methodology settings of the study. Further research may closely watch a growing regulatory legitimacy category by interviewing more governance actors.

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APPENDICES

A.1 Stakeholders' interviews

A.1.1 Interview topic guide (Case A and B)

- Introduction of the researcher, the aim of the project (http://nextgenwater.eu/), and the case study.
- Informed consent form.
- General structure of the interview.
- Do you have any questions before we start?

Start recording

INTERVIEWEE INFORMATION	
Primary questions	Prompts
What is your role in your organisation?	Any other professional activity?
CASE STUDY CONTEXT	
Primary questions	Prompts
Can you tell me more about the context and history of the scheme/area?	Water, wastewater management background (issues). Urban area/agriculture.
Can you give me an overview of the scheme/project?	Water, waste, agriculture related.
Why has the scheme been put in place? By whom? How?	
Does the scheme comply with any legal rules/government goals? Is there any regulation, law, legislation associated with the scheme?	Any changes in the law?
ORGANISATION AND STAKEHOLDERS	
Primary questions	Prompts
How and why has your organisation gotten involved in the development of the scheme?	
Your role and role of your organisation in the development of the scheme?	Which steps of the development did you have an impact on?
How important is the scheme for your organisation?	

ORGANISATION AND STAKEHOLDERS	
Primary questions	Prompts
Did/do you work with other stakeholders/organisations?	How did you work with them? Additional stakeholders weren't willing to get involved?
What do you see as the aim of the scheme?	What do you expect from the scheme?
What do you think will be the impact of the scheme (+/-)? Any impacts on the local area? Any impacts at a national/global level?	What are the benefits of the project so far? What will the benefits be in the future?
Any benefits? Any costs? Do you have any concerns?	
Does the scheme make sense to you?	
How do you relate the scheme to your life? How do you relate the scheme to your business?	
How do you relate the scheme to farmers, tourists, visitors, workers at the brewery (Case B only), and the public lives?	
How is the development of the scheme going so far?	Output, deliverables, action plan.
COMMUNITY OF PRACTICE MEETING (STAKEHOLDERS VIEWS)	
Primary questions	Prompts
Have you been to the CoP meeting?	Who came to the CoP? Who did not come? Whom would you like to see coming?
What did the CoP meeting bring to you? Did you or stakeholders ask questions?	
What has been the role of CoP meetings in the development of the scheme?	
What has been the general outcome of the CoP meetings so far?	
Other than CoP meetings, to what extent has the scheme been publicised? How has it been publicised, and by whom?	
Who do you think knows something about the scheme?	
Can you tell me more about the community centre (Case B only)?	

GENERAL PERCEPTIONS AND COMMUNITY PRACTICE (PUBLIC VIEW)	
Primary questions	Prompts
What was/is the result of people's interaction with the scheme? Any other interaction appart from the community of practice? How are people included in the decision-making process?	
How have people reacted to the scheme? Did you see any change in opinions about the scheme between before and now?	Give one word to define participants reactions. What did people was missing for the scheme to be more accepted?
Did they ask questions? Does the scheme make sense to other stakeholders/people?	Whom? Why? What meaning do people attribute to the scheme?
Do other stakeholders/people have any concerns?	Whom? Why? How do you/they feel about it?
Did you hear any oppositions? Did you hear any positive elements from the stakeholders, members of the public, farmers, visitors, businesses, and workers at the brewery (Case B only)?	Whom? Why? Whom? Did they ask to go on a tour?
What impact (if any) do people think the scheme might have on the local area? On the country? At a global level?	
Do people see any direct benefits to the scheme? If so, what are they? Do they see any costs or negative impacts to the scheme? If so, what are they?	Risk
How do people understand the water cycle? How do people relate the scheme to their lives (professional and personal)?	How do they relate the scheme to the water cycle
To what extent is the scheme accepted?	

LOOKING FORWARD	
Primary questions	Prompts
What do you think needs to happen for the scheme to be more accepted? Is there anything you would like to be more involved in?	What did people was missing for the scheme to be more accepted?
What do you think about circular economy in general? Definition of the CE: “A circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems.” (Ellen MacArthur Foundation, 2017)	What does the CE mean? How does the project relate to that?
Is there any further information you would like to share?	

Closing instructions:

- Offer a copy of the interview transcript. Ensure the confidentiality of the data.
- Snowballing.
- Thank the interviewee for their time.

Stop recording

A.1.2 Interview topic guide (Case C)

- Introduction of the researcher, the aim of the project (https://ultimatewater.eu), and the case study.
- Informed consent form.
- Description of general structure of the interview.
- Do you have any questions before we start?

Start recording

INTERVIEWEE INFORMATION	
Primary questions	Prompts
Could you please introduce yourself? What is your role in your organisation?	Any other professional activity?
CE CONCEPT	
Primary questions	Prompts
What do you think about the CE concept?	
CASE STUDY CONTEXT	
Primary questions	Prompts
Can you tell me more about the context and history of the project/system and the surrounding area? Can you give me an overview of the project? Why has the project been put in place? By whom? How?	Water, wastewater, urban area/agriculture.
Does the system/project comply with any legal rules, government goals or laws?	Have there been any changes in laws, regulations, government goals? e.g., Industrial Emissions Directive
ROLE OF THE ORGANISATION	
Primary questions	Prompts
How and why has your organisation got involved in this project? What is your role and the role of your organisation in this project? How important is this project for your organisation?	What stage did you organisation get involved at?

STAKEHOLDERS	
Primary questions	Prompts
Did you work with other partners and/or stakeholders involved in the project? Why did those partners and/or stakeholders take part in the project? What benefits will they get from the project? Are there any stakeholders you think should be more involved in the project?	E.g., industry, municipality. What are their roles in and influence on the project and at what stage did they play a part?
PERSONAL VIEW OF INTERVIEWEES	
Primary questions	Prompts
What do you see as the aim of the project?	
What do you think will be the impact of the system/project? Any impacts on the local area? Any impacts at the national and global level? What do you think will be the benefits of this project?	What are the positive and negative impacts? Are these immediate or impacts in the future? For whom?
Do you have any concerns regarding the project?	
Does the scheme make sense to you?	Why?
To your opinion, how does this system/project relate to the lives of end users, customers, local citizens, the general public, and policy makers?	What impact might it have on their lives?
VIEW OF OTHER STAKEHOLDERS	
Primary questions	Prompts
How is the scheme publicised? How? By whom? Who do you think knows about this project? Can you tell me more about the visitor centre? Do you plan to use the visitor centre to advertise the project? How do stakeholders, end-users, customers, local citizens, the general public, policy makers, and third sector organisations interact and are involved with the project?	E.g., outreach strategy. Who came? Did people ask question? What was said to them and to you?

VIEW OF OTHER STAKEHOLDERS	
Primary questions	Prompts
What is/was the impact and results of people's (stakeholders, end-users, customers, citizens, public, and policy makers) involvement and interaction with the project? What was the general outcome? Are people included in the decision-making process? If so, how are they included? Did you hear any reactions from stakeholders, of end users, customers, local citizens, the general public, and policy makers? Have there been any changes in reactions between before and now? How would people react? Did they ask questions? Does the system/project make sense to stakeholders, end users, customers, local citizens, the general public, and policy makers? Have you heard any oppositions? What would they be? What impact do people think the scheme might have on the local area? On the country? At a global level? What would they think the impact is? Do people see any direct benefits of the project? What are these? Do people see any negative aspects or concerns? How do stakeholders, end users, customers, local citizens, the general public, and policy makers relate this project/system to their lives? How would they relate to it?	

LOOKING FORWARD	
Primary questions	Prompts
To what extend is this system/project accepted? What do you think needs to happen for this system/project to be more accepted? Given the following definition, what do you think about the CE in general? Definition of the CE: “A circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems.” (Ellen MacArthur Foundation, 2017)	
ADDITIONAL QUESTIONS	
Primary questions	Prompts
How did you react when you heard about this project? What do you expect from this project? What do you think stakeholders,end users, customers, local citizens, the general public, and policy makers expect from the project/system? Is information and results about the project shared and/or accessible? If so, how and whom is it shared with? What do you think the feelings of your wider customer base will be towards this project? Would you consider explaining this project to your customers? What do you think the reaction of the customers would be? How important is public outreach for you and your company?	How is the information used? What would be the impact of the scheme on your company/marketing? Have you heard some feedback already?

ADDITIONAL QUESTIONS	
Primary questions	Prompts
How do you consider and take into account people feedback, comments, views from stakeholders, end users, customers, local citizens, the general public, policy makers and third sector organisation in your activity?	
ADDITIONAL QUESTIONS	
Primary questions	Prompts
What are you and your company willing to compromise when implementing this kind of circular systems/projects? What motivates you in the first place, to adopt circular systems? Is there any further information you would like to share?	

Closing instructions:

- Offer a copy of the interview transcript. Ensure the confidentiality of the data.
- Snowballing.
- Thank the interviewee for their time.

Stop recording

A.1.3 Data structure for stakeholders' interviews (Case A)

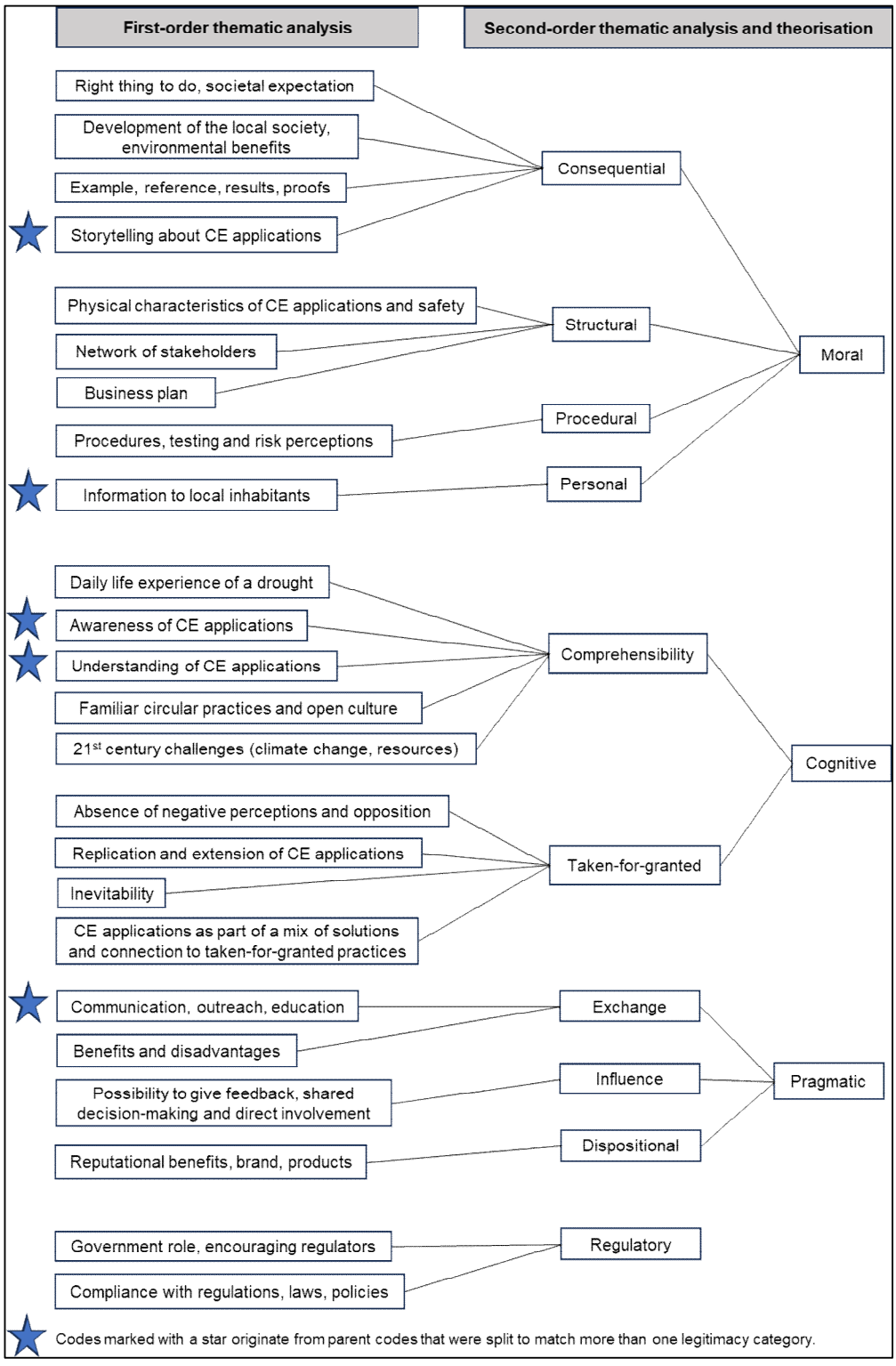


Figure 19 – Data structure showing the first- and second-order thematic analysis and the theorisation for stakeholders' interviews in Case A

A.1.4 Data structure for stakeholders' interviews (Case B)

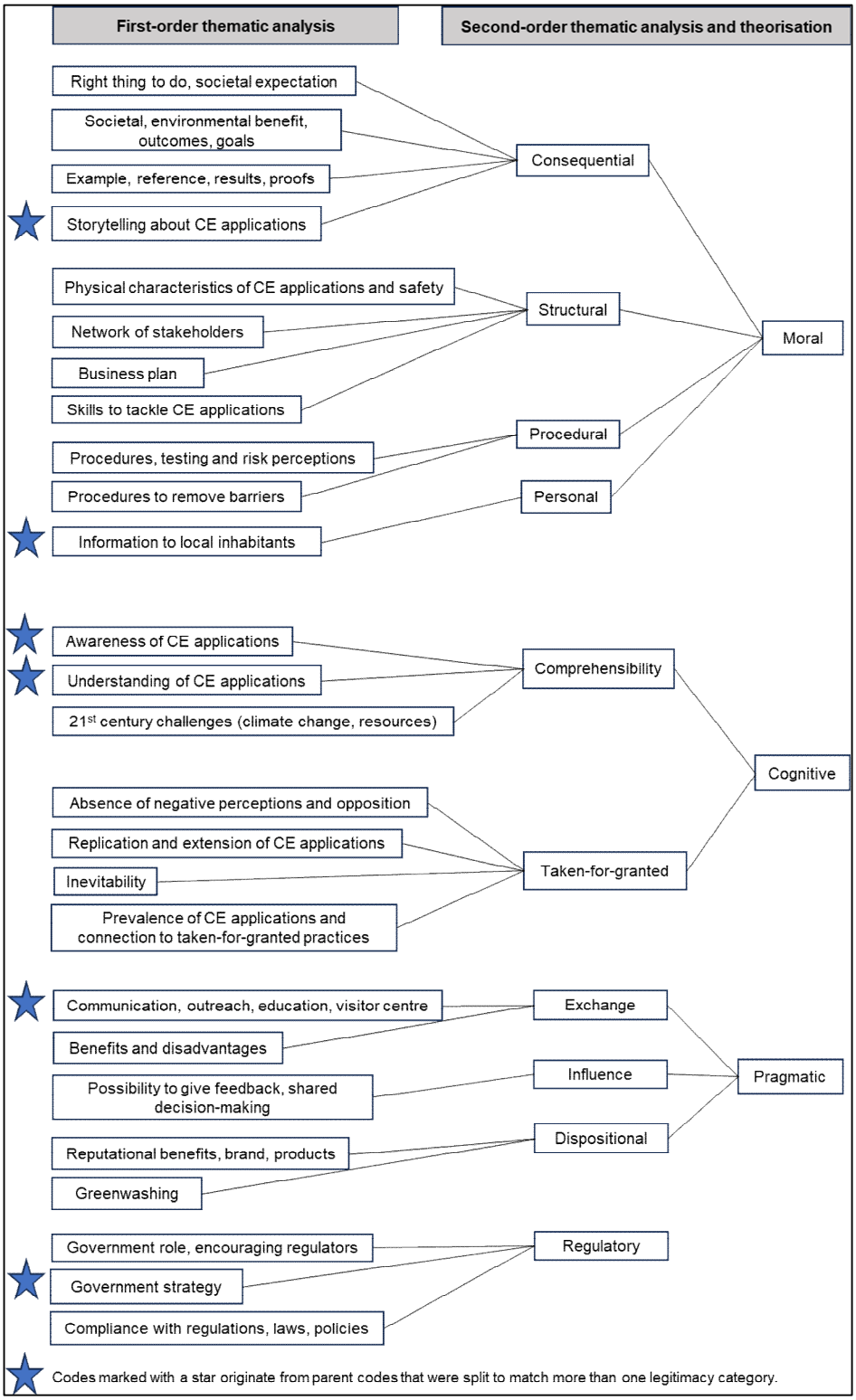


Figure 20 – Data structure showing the first- and second-order thematic analysis and the theorisation for stakeholders' interviews in Case B

A.1.5 Data structure for stakeholders' interviews (Case C)

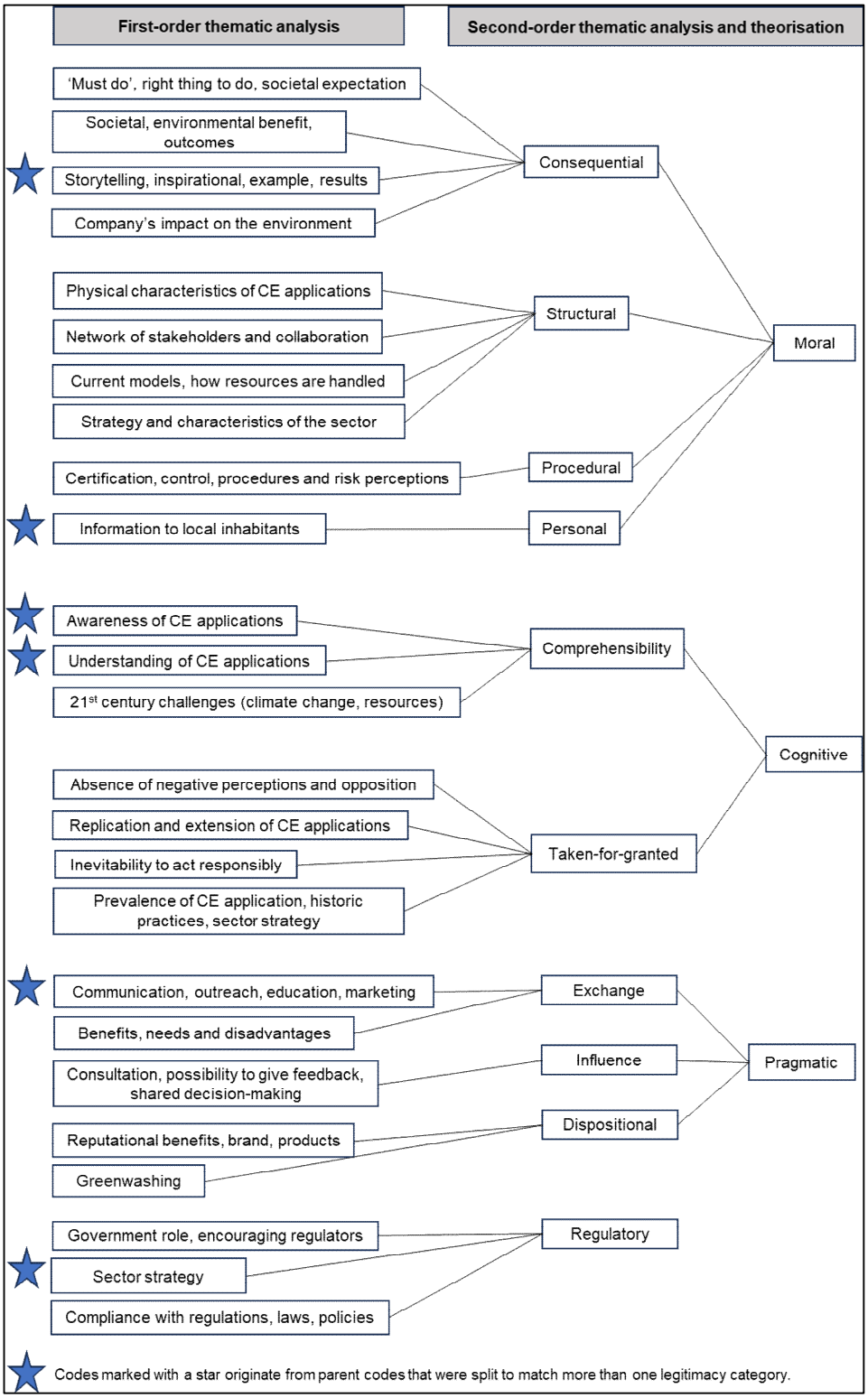


Figure 21 – Data structure showing the first- and second-order thematic analysis and the theorisation for stakeholders' interviews in Case C

A.1.6 Illustrative quotes of the four legitimacy categories and the three cases studies for stakeholders' interviews

Table 24 - Illustrative quotes of the four legitimacy categories for the three case studies for stakeholders' interviews

Legitimacy category	Case	Interviewee ID	Quote
Moral Consequential	A	25	"The main thing on [Case A location] is farming and business related to tourism. If they can't get water, they don't want to buy houses. […] it's so important that they have water."
		5	"[…] I think that we will succeed to our ambitions. But of course that after we must show to the region, to the people, that our concept, we can propose now, we can implement now, it is workable, to have bigger projects."
	B	13	"[…] what they have to realise is not the gain on the water resources, on the water price, which is important, [it] is the gain on the pollution and on the water resources and the overall impact because if you purify water then […] the ecosystem locally [is] much more […] resilient, optimised, robust efficient […]. It will be an impact on the agriculture, […] on the health, […] on the quality of the air […]. […] you are talking about the impact it could have on […] the society living there and, on the biodiversity, […]."
		19	"You know, because I think that consumers at the end of the day are going to demand from the industries, you know, that they are going to be much more responsible. I think that there is already a quite a big pull, you know, quite a big demand from consumers, you know, that they want their products, for example, not to be wrapped in plastic all the time."

Legitimacy category	Case	Interviewee ID	Quote
Moral consequential	B	7	“The most obvious impact of this project is showing that it is possible, […] it is feasible, and even in a place where water engineering and water technology is the top quality.”
		29	“If they show this can be done, they set a new standard maybe”
		10	“but the time is now not to focus not only on plans but focus more on doing things completely in which we know the outcome is uncertain, we take some risks but hey, let’s go for it and see how it goes.”
	C	47	“[…] a very willing management team […] and were keen to see what they could do to reduce their carbon footprint, reduce their environmental footprint […].”
		35	“[…] I wouldn’t think it would make a slightest bit of difference. It’s an absolute drop in the ocean […] I think it would be a very token gesture.”
		47	“A bit of pressure that actually the wider whisky industry was also looking at some of these things as well. So just some awareness. […] A sense that they probably were falling behind maybe.”
Structural legitimacy	A	30	“they chose [location] because they had connections here. […] It is important to have the scientific knowledge, it is important to have the financial means to be able to do this project, but […] the most important thing is to have the local anchoring or legitimacy.”
		30	“[name] is very trusted within this community. When [name] comes and asks people if they want to help, they do […] because they have seen that [name] has contributed so much to this community in the first place.”

Legitimacy category	Case	Interviewee ID	Quote
Structural legitimacy	B	7	“it’s not a coincidence that we could start this project within that territory. They are considered the most innovative [organisation type].”
		24	“[…] at the end of the day this kind of project has much more to do with people than with places or environments […]. And I think that they are the right people in place.”
		7	“[…] the water board […] It turned out to be one of the most open-minded and innovative people. So I think it’s not a coincidence that we could start this project within that territory.”
		13	“Some of them [stakeholders] were very convinced, others were […] not sure that circular system are better than open ones. I heard a few people who say I am not convinced that the closed systems are better than the open […] I think it’s not elaborated […] as I explained, you have an obstacle and you think if you say this obstacle doesn’t exist, we don’t need this […] a bit disappointed.”
		13	“in that the worldwide industry, is still not very much experienced how to reach a circular system […] there are some steps to respect and if you explain it […] very theoretically what they have to do […] and they say okay, we are going to [do] simpler and better […] after a few months or years of experience then they come back and say oh, not so easy.”
		24	“[…] it’s very important to really have business cases with them, because if our technologies is working quite well, but it’s too expensive, it is not going to work in the end.”
		10	“[…] our own programme which we create every 4 years, with the [program], there are also financial possibilities to help all kinds of partners to reserve, conserve water in the area.”

Legitimacy category	Case	Interviewee ID	Quote
Structural legitimacy	B	7	“they needed to […] implement something. The second was that they were looking for solution which would be implemented within the territory of the [building].”
	C	48	“[…] we need to go circular, we need to value all of our materials and resources and look at more responsible models for managing them, and making sure that everything is used and used and used as many times as possible at the highest value as possible as well. […] So it should be accepted […] models have to change and we have to do things differently.”
		37	“[…] we started our environmental strategy ten years ago. And as a sector, we have identified environment as non-competitive. […] we had the transitioning to a CE as one of our key themes. So it has been there for a while, and it is […] something that is quite established with the distillery sector […] that whole kind of circularity is quite standard and built into the sector.”
		36&42	“The sector as a whole is aiming to be carbon neutral by, I think […] 2040 they have got in their strategy. And the [organisation] strategy has been signed up by all members companies. […] they do place a very high value as a sector on environmental performance.”
Moral Procedural	A	12	“[…] the main concern is, […] sickness and bacteria and viruses that could be in the water. […] if you’re planning to use it for drinking water or in cooking, then you’d have to make sure that the water is suitable for drinking.”
	B	13	“[…] as I explained, you have an obstacle, you are fair about this obstacle and you think that if you say this obstacle doesn't exist, we don't need this, let's stay where we are in a comfortable zone then the problem is solved. […] they try to drop kind of things like that result in a number of not sure it makes sense, or it's going to

Legitimacy category	Case	Interviewee ID	Quote
			consume a lot of time and energy to make it work so maybe it's better to carry on as we do. You know these kinds of thing which are […] very a bit disappointed."
Moral Procedural	C	39	"their [public] concerns might be […] how the fertiliser is made, where it's being used, and where it's being used, does it add to eutrophication? On the water one, they might be concerned about […] what happens to any detergents or solvents that are used in the cleaning process. And the heat one, I think there's less immediate concerns about that."
Moral Personal	A	2	"We have with all the inhabitants. And we gather them and the local […] have an open café for them. […] important because it's both farmers and it's lot of stakeholders among the public".
	B	10	"[…] because we have a lot of publicity, sometimes I get invited in local meetings, we call it an environmental café, […] that's where all kinds of issues on environmental sustainability subjects in a café or a bar, there are lots of people and you can tell them about this project".
Cognitive Comprehensibility	A	3	"[…] overall there is a positive view from the public here on [location] of drinking treated wastewater because we have a lack [of water] and had it for many years […] so it is so obvious for many people."
		18	"The situation in [location of Case A] […] it has been so severe for so long, this lack of water, […] it has been so obvious to the people of [location of Case A] […] most people are very grateful that we are no entering an era of really practical solutions."
		20	"Lots of people […] they have been using rainwater to save water."
		23	"[…] every year, […] the media talk about the lack of water and how we are supposed to really save water in every aspect […] I think you can say that the water

Legitimacy category	Case	Interviewee ID	Quote
Cognitive Comprehensibility	A	23	question […] is quite high on the sort of top of mindset in the people on [Case A location].”
		2	“They [testbed] have been quite visible in a lot of media, television and radio and newspapers.”
		31	“[…] it’s so much for me to understand also who is who and what is what. So I guess I get a bit confused.”
	B	10	“It was in the national television.”
		8	“I doubt there is a high awareness of the impact that this [CE applications} would have.”
		10	“There are a lot of visitors there every year [visitor centre] […] ordinary people can learn what you can do with water.”
		19	“I believe that a large majority of the public is still not really familiar with the fact that circular systems can contribute to a greener planet […] I think when people see with their own eyes that something is actually working and that we can, for example, design and build and operate a system, that is completely closed, I think this will be an eye opener.”
	C	45	“Because it's a product that you see anywhere […] it's going to be a way of communicating to those people who drink whisky to make them conscious of what they're drinking. And maybe through that and through their own campaigns, create awareness of why it is important to think about our planet.”
		43	“I wouldn’t have though the nutrients recovery or the heat recovery piece would make sense to many people, they wouldn’t understand.”

Legitimacy category	Case	Interviewee ID	Quote
Cognitive Comprehensibility	C	48	“There is definitely a lack of understanding around the circular economy in general, not just with the general public, with businesses as well.”
Cognitive Taken-for-granted	A	18	“[…] if we do have a situation where we have positive results from these water management projects […] I really hope that they will be spread around the world, and that they will be both inspirational but also be really accessible for people from other parts of the world, because.”
		3	“[…] we have many [municipalities] […] and they want to implement on their own people […] we also had different consults firms, we had 100 consults firms visiting the testbed.”
		25	“I think it [CE] is a matter of living. We have to talk about circular economy much more and this project is spot on.”
		6	“I would say that the wastewater project is a result of all the other projects in [Case A location], because we saw that we have to take care of the wastewater […] we have built a spawning pound […]we have built a small phosphorus trap for farmers […] they [projects] are connected that way to the testbed.”
		3	“I think it is an eye opener for the general public, living on Gotland, that there are different solutions of one problem.”
	B	14	“So in that sense it is a very interesting place to showcase what you can be done. So I think through that you will have opportunity to install maybe another municipalities, a lot of locations. That will be really help the transition towards circular economy in different hubs.”

Legitimacy category	Case	Interviewee ID	Quote
Cognitive Taken-for-granted	B	10	“What we see is a lot of interest in the system, we see already that there is a lot of people or companies or government or organisations that already contacted us and been round, and so that’s good.”
		14	“We are looking at increasing the quality […] for bottle washing or other industrial uses.”
		14	“It’s [CE] very necessary. I don’t think we can keep on taking materials using them and throwing them away.”
		16	“they’re all about the sustainability of the beverage sector. And they’re constantly looking for ways to reduce water use and bring down the amount of water you need per […] litre of beer. And that comes from efficiency within the facility, but it also comes from water recycling.”
		29	“all the breweries, all the companies that are using water, they’re all thinking about […] how you act responsible as a company, […] how you care as a company for your people/planet/profit, or the profit they can usually think about how they want to do that part of it, especially how you care as a company for people and you care for the planet. That is something every company thinks about.”
	C	43	“And it’s something that can be replicated throughout their industry. You know, there are lots of other distillers with the same problems in similar type of locations, got coastal access, etc, etc. So again, it allows them to develop these processes potentially for some of their other sites as well going forward.”
		39	“There is so much heat wasted from all sort of factories […] the ideal in time is actually you are not wasting […] and it’s captured and fed back […] there is heat recovery and that’s used to help heat homes.”

Legitimacy category	Case	Interviewee ID	Quote
Cognitive Taken-for-granted	C	44	“I think there is a lot of opportunities, or synergies between different organisations that we could maximum benefit from.”
		43	“It [CE] has to happen, it has to be a key to a lot of what we do.”
		37	“[…] we started our environmental strategy ten years ago. And as a sector, we have identified environment as non-competitive. […] we had the transitioning to a CE as one of our key themes. So it has been there for a while, and it is […] something that is quite established with the distillery sector […] that whole kind of circularity is quite standard and built into the sector.”
		39	“The CE, it’s not a solution on its own. […] it has to be part of an overall greenhouse gas reduction targets.”
Pragmatic Exchange	A	18	“I know that if they would have a very, very much better water situation, I think more people would build houses in [location], there would be more people moving to this part of [location], and that would of course have very, very positive effects.”
		4	“The main thing is that probably they [locals] will have more reliable water.”
		6	“They need [number] litres of water per day. So for the farmers and landowners, it [CE applications] is so important.”
		17	“Quite a lot have been written about this project […] there was a book […] which described a lot of local projects that has to do with water.”
		3	“There were hundreds of people […] we informed about the project, and […] we asked them questions about what they would think about drinking treated wastewater […] what kind of information they wanted.”

Legitimacy category	Case	Interviewee ID	Quote
Pragmatic Exchange	B	24	“For the farmers surrounding them, they […] eventually can use the water to irrigate.”
		24	“For us as well as a company, because we […] have a place to show the world how our technology is working.”
		29	“They can learn from it, and improve the system.”
		8	“needs to invest in quite expensive technology, it might be not a good deal for them but if they understanding the long-term vision and economic gains they would have from this kind of application.”
		13	“[…] any reduction of this water consumption is a plus”
		10	“Sometimes I get invited in local meetings […] there are lots of people and you can tell them about this project.”
		16	“I think public perception is a very important part of it. I think because it’s so close to a visitor centre, it would be really nice to see visitors go close to it or in, or outside. There was talk of incorporating it into the facility tour.”
	C	35	“The farmers are able to reduce the amount of artificial fertilisers that they are using […] it’s reducing their carbon footprint.”
		35	“Other farmers need to see the benefits of doing […] sludge […] the growing benefits to the crop […] and it is only going to take time.”
		37	“One of them is to help share best practice. […] when [organisation] are working on really innovative projects and they’re successful, then sharing it with our members will help everybody move forward and help us with our sustainability strategy.”
		34	“They expect that money to be paid back […] through wider group sales.”

Legitimacy category	Case	Interviewee ID	Quote
Pragmatic Exchange	C	46	“[…] so anything that can be done to reduce costs in the chain […] If companies are following these pathways that there’s benefit for everybody in the chain.”
		37	“I think it was very successful having the additional [conservation organisation], which was providing information around the [previous] project at the distillery. I think it was very positive.”
		43	“That’s where the education piece comes in, and the access to visitor’s centre and marketing and telling people what you are doing.”
		43	“They like to collaborate, they want as many people to get involved as possible.”
Pragmatic Influence	A	2	“[…] they [landowners and farmers] feed in a lot of information. It could be experiences regarding water, […] they could have good ideas to solve issues and challenges both technical but also regarding how to inform and how to discuss with the locals.”
		5	“Communal people, the political people are part of the project it is also a key to succeed with a project, to have other ideas, experiences from people [...] they informed us about the problems during the year, the why and how, help us also with some idea […] it is a very good cooperation.”
		3	“they approached the [organisation] and asked the [organisation], ‘could you please help us find a solution for our water situation, so our businesses can grow on this part of the island’.”
	B	14	“The visitors are not included [in decision-making process].”
		16	“I don’t think it was really open to public debate […] it’s a closed, private, historic site.”

Legitimacy category	Case	Interviewee ID	Quote
Pragmatic Influence	B	10	“There’s a lot of people who come with a lot of ideas, and wondering around, […] so what we do is when people come with new ideas of things, there is a board […] we always decide what we do with new initiatives or with new thoughts.”
	C	47	“They would want to inform people about it. I am not sure they would necessarily engage them in the decision-making process directly in this case.”
		47	“It’s probably a bit overly technical to worry about too much.”
		48	“The problem with community consultation is that lack of understanding […] you might end up creating more issues if you ask for views, and then they are not relevant so you don’t take them on board, and then that can create a bit of tensions.”
		34	“They are not a small company […] a lot of companies now over a certain size […] they may have suggestions schemes.”
Dispositional Legitimacy	A	30	“[…] he’s very trusted within this community, so, when he comes and asks people if they want to help, they do want to help because they’ve seen that he has contributed so much to this community in the first place. So it’s very important to have those kind of key figures, or key persons to be able to make this work.”
	B	29	“And taking care of the planet, and it has a very strong story. And it’s also very authentic. Sometimes you can hear these stories and it smells like greenwashing, and in their case it’s just a very authentic drive.”
		24	“They can have a very good impression about the aims of [the adopting company] […] people have started to be more aware of environmental things.”

Legitimacy category	Case	Interviewee ID	Quote
Dispositional Legitimacy	B	14	“There were some issues in terms of smell […] that is something we should manage carefully […] if you get bad public perception, especially in a place with this kind of reputation for beer […] is something we really have to be careful with.”
	C	48	“And I know that this is something [the distillery] look at is that there heritage of their brand and ensuring that fits their current model, and also that their model into the future as well. So I think the brand thing was probably a key driver as well.”
		39	“They [adopting company] could play on it as being a pioneer […] then years ahead […] they could say, everybody is doing it now, we led the way.”
		48	“Circular economy can bring that strengthening of the brand.”
		46	“[…] any brand that is involved in recycling of any sort and showing that they are being as kind as possible to the environment, this can only be a positive for the company […] and the brand associated with it.”
		36&42	“I guess again for the customers, it’s more that wider aspect that they can show that they are taking their environmental responsibility seriously, and they are driving down their impact on the environment. […] looking at individual projects probably doesn’t really make a huge difference to the customer. It’s when it’s put in context with everything else and used as part of being able to demonstrate that it’s not just greenwash[ing], that they are actually doing something, I think that's where the benefit is.”
Regulatory legitimacy		30	“the personal benefit is that […] knowing that we will have access to water, that we don’t have to have as many restrictions.”

Legitimacy category	Case	Interviewee ID	Quote
Regulatory legitimacy	A	5	“There are very good initiatives in Sweden, and I think that this is the reason of the project, to test and evaluate the innovative solution in order to find circular technologies and systems for future water supply solution.”
		2	“so we thought that they [authorities] might be very negative to do anything here. But the last time we had a meeting they were very interested and wanted to help.”
		2	“we have those COP meetings, for example, with the authorities. […] what they could see now […] one of the challenge is to work within the regulations.”
	B	8	“To be used, and also for discharges in the environment, the wastewater […] the local regulation, the national regulation so that's why they wanted to implement some novel technologies to help them with that. […] to get to that level of clean water able to be discharged otherwise they have to pay fines for not meeting the threshold.”
		10	“[…] what’s nice to know is that we are going in the Netherlands to a new kind of regulation system, […] this regulation is meant to help sustainable entrepreneurs to get the things faster in regulation […] check the laws […], they took the Abbey as an example of why the Netherlands need a new kind of regulation.”
		8	“But we also know that the policies are changing more favourable of circular solutions.”
		14	“[…] the government this plan, I think they want to have a circular economy by 2050.”
		10	“In the long term, of course, we learn a lot of that, and […] we as a water board can update our policy about four or five or six years.”
		14	“But if you really look what is in the law [related to circular economy], I don't think there's anything really there.”

Legitimacy category	Case	Interviewee ID	Quote
Regulatory legitimacy	B	29	“There was a big [of a] struggle where to place this project in our whole system of regulations […] almost to the point when they said, “well, this is just not going to work”.”
		14	“[…] sometimes the guidelines, for example, in terms of water quality they are helpful, but if you’re setting up a new system, it is quite difficult to directly meet others requirements. […] of course you should at some point […] make sure you do meet the criteria, but it should be some kind of grade transition somewhere in between where you can […] really start working on the technology without directly being fine.”
		10	“It is not easy this kind of project because it is [away] from the normal path, so it takes time […] if you work with dirty materials, you have much heavier permit system than normally.”
		13	“[…] they must […] water quality. So I don't know which one [regulation] they follow, if it is water quality, agrifood quality, beer quality.”
	C	36&42	“[…] but we are keen that people go beyond that [regulations] […] basically it’s pushed in the circular economy. Once you go beyond the regulation, you really start to tackle the sustainability issues rather than merely complying with what we demand.”
		36&42	“[…] the sector as a whole […] are looking at water efficiency ranges. The [sector association] strategy is looking to set a range for water consumption per litre of alcohol produced.”

Legitimacy category	Case	Interviewee ID	Quote
Regulatory legitimacy	C	36&42	“[…] with respect to sort of going beyond compliance is a lot of companies don’t necessarily fear [regulators] coming onto site as they see it more of an opportunity” (C, 36&42, R3)
		37	“It’s really important to have these examples when talking to regulators and government and other stakeholders […] to help us shape the right policy framework and regulation framework, funding R&D framework.” (C, 37, R)
		47	“I think you have to be a little bit careful with end of waste regulations to make sure that you don't put contaminants into a food supply.” (C, 47, R)
		34	“That [regulations] continues to tighten to protect the environment.” (C, 34, R1)
		34	“water reuse is still a pretty small area of industry in the UK, but if it did take off massively, I'm fairly certain there would be new legislation.” (C, 34, R2)
		48	“[…] especially when we're looking at innovative ways of using organic waste, a lot of the regulations are quite tight, and they need to change a bit in order to allow for new innovative models to become more the norm. So yeah, quite often some of the regulations can be quite restrictive.” (C, 48, R)
		45	“Because we are in food, we always have to make sure that whatever we do complies with all food regulations.” (C, 45, R).

A.2 Public interviews

A.2.1 Interview topic guide

Participant number: …

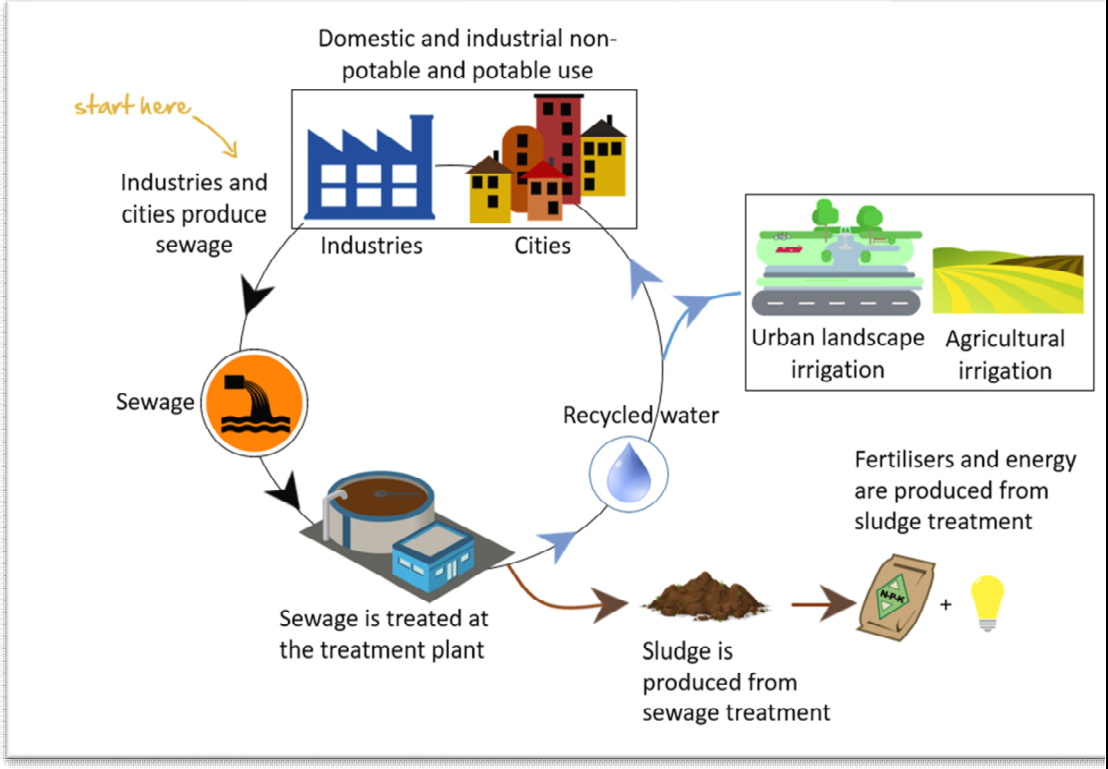
- Aim of the research: understanding the societal perceptions towards circular systems.
- Informed consent form.
- Describe the general structure of the interview: (1) Questions regarding the survey previously taken, (2) introduction of a local circular system, (3) interviewee's opinion about it.
- Do you have any questions before we start?

Start recording

GLOBAL SCALE
As part of the survey you previously took, you were asked about the values that are important to you, your awareness regarding waste management and the circular economy, and your views on companies that are adopting the circular economy in the water sector. Do you have any comments about the survey? What did you think when you took the survey? What do you think about the term "CE"? As part of the survey, a diagram of the general idea of a circular economy system for the water sector was displayed. Wastewater from cities and industries can be used as a resource, to produce recycled water, fertilisers for growing food, energy, and other materials (see diagram below). What did you think about the system displayed in the survey? Did you have any concerns? Did you see any advantages? In the survey we asked, do you remember how you answered that? Prompts (survey statements): - Systems like this are a good way to help us cope with future challenges. - I expect that systems like this would be designed and managed in an appropriate way. - I would have a good opinion of a company that adopted a system like this. - I feel it is safe to use products (e.g. food, energy) from a system like this.

GLOBAL SCALE

- I would feel comfortable using products (e.g. food, energy) from systems like this.
- The system is understandable to me.
- Systems like this are necessary.
- It is obvious that systems like this should be adopted.
- Systems like this are aligned with my values.
- I think that people could have an influence on the design or operation of a system like this.
- I think that I, or my community, could benefit from this system.
- I think that the company would value people's opinions about this system.

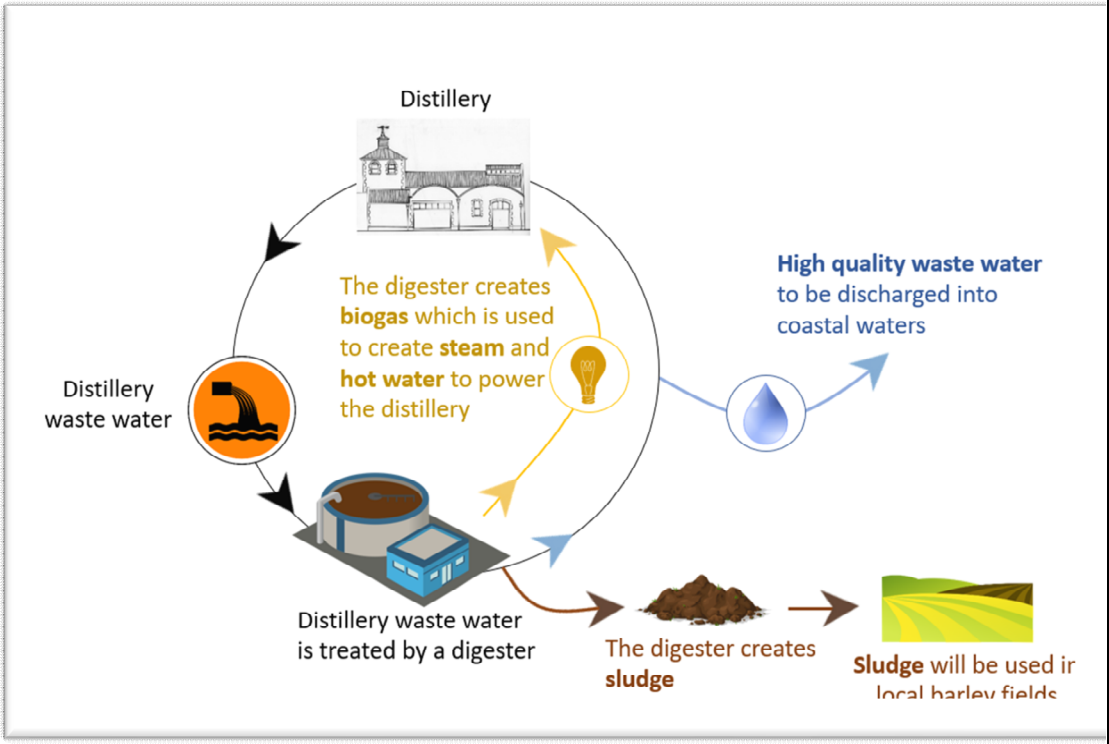


Images credits for the diagram: Tracey Saxby and Jane Hawkey, IAN Image Library (ian.umces.edu/imagelibrary/).

LOCAL SCALE

Here is a circular system that was adopted by a distillery. The production of soft drinks and whisky generates distillery wastewater. Wastewater from the distillery can be used as a resource, to produce fertilisers to grow food, high quality water to be discharged in coastal waters and energy to power the process of whisky production (see diagram below).

LOCAL SCALE



- What do you think about this system? Do you have any concerns about this system? Do you see any advantages to this system? (moral & cognitive & pragmatic legitimacy)?

If you were to visit the site:

- How would you feel about drinking soft/whisky drinks produced by a company that uses recycled water for cleaning processes?
- How would you feel about drinking whisky that was produced with malt that was grown with this sludge/fertiliser recovered from wastewater?
- How would you feel if you were told that the site [distillery] is powered by energy generated by sludge treatment [hot water, steam]?
- Is the system understandable to you? *(cognitive)*
- What is the aim of this system for you? *(cognitive & moral & regulatory)*

What are the benefits and costs of this system on the society and the environment?

LEGITIMACY PROMPTS

<u>As a consumer:</u>

- If you were consuming or buying a soft/whisky drink produced at this site [distillery], what benefits would you see as a consumer? (pragmatic)
- Would you have any concerns about this system, as a consumer? (moral & pragmatic)

LEGITIMACY PROMPTS

<u>As a local citizen:</u>

- If this circular system was installed next to your house, what benefits would you see as a local citizen (*for you, the society, the environment)*? (pragmatic legitimacy)

Would you have any concerns about this system, as a local citizen? (moral & pragmatic legitimacy)

<u>As a member of the general public:</u>

- What benefits would this circular system bring to you, as a member of the general public (*for you, the society, the environment)*? (pragmatic legitimacy)

Would you have any concerns about this system, as a member of the general public? (moral & pragmatic legitimacy)

LEGITIMACY PROMPTS

- Do you think this system is a good idea? Why? (moral legitimacy)
- Do you feel this kind of system is the way we should go (moral & cognitive legitimacy)?
- Do you feel comfortable being around this kind of system (cognitive legitimacy)?
- Do you think you could have an influence or a role in the development and operation of this kind of system? (pragmatic legitimacy)
- Who would you like to see involved in the development and operation of this kind of system? (moral & pragmatic legitimacy)
- Do you know any rules about the circular economy? Do you think this system complies with those rules? Does the existence of those rules make you feel more confident about circular systems?
- What do you expect from this kind of system?

ADOPTING COMPANY

Let's take the example of a distillery that produces soft/alcohol drinks and that adopted this system (pragmatic & moral legitimacy).

- How do you feel about the company that adopted this system?
- Would that change your view of the company?
- How would that affect your perception of the brand of that company?

CE

- What could be done to improve your views on circular systems?

"A circular economy is based on the principles of designing out waste and pollution, keeping products and materials in use, and regenerating natural systems." (Ellen MacArthur Foundation, 2017)

CE
- What do you think about the circular economy? What are the positive aspects and negative aspects? Is it realistic? Is it useful?

Stop recording

A.2.2 Data structure of public interviews

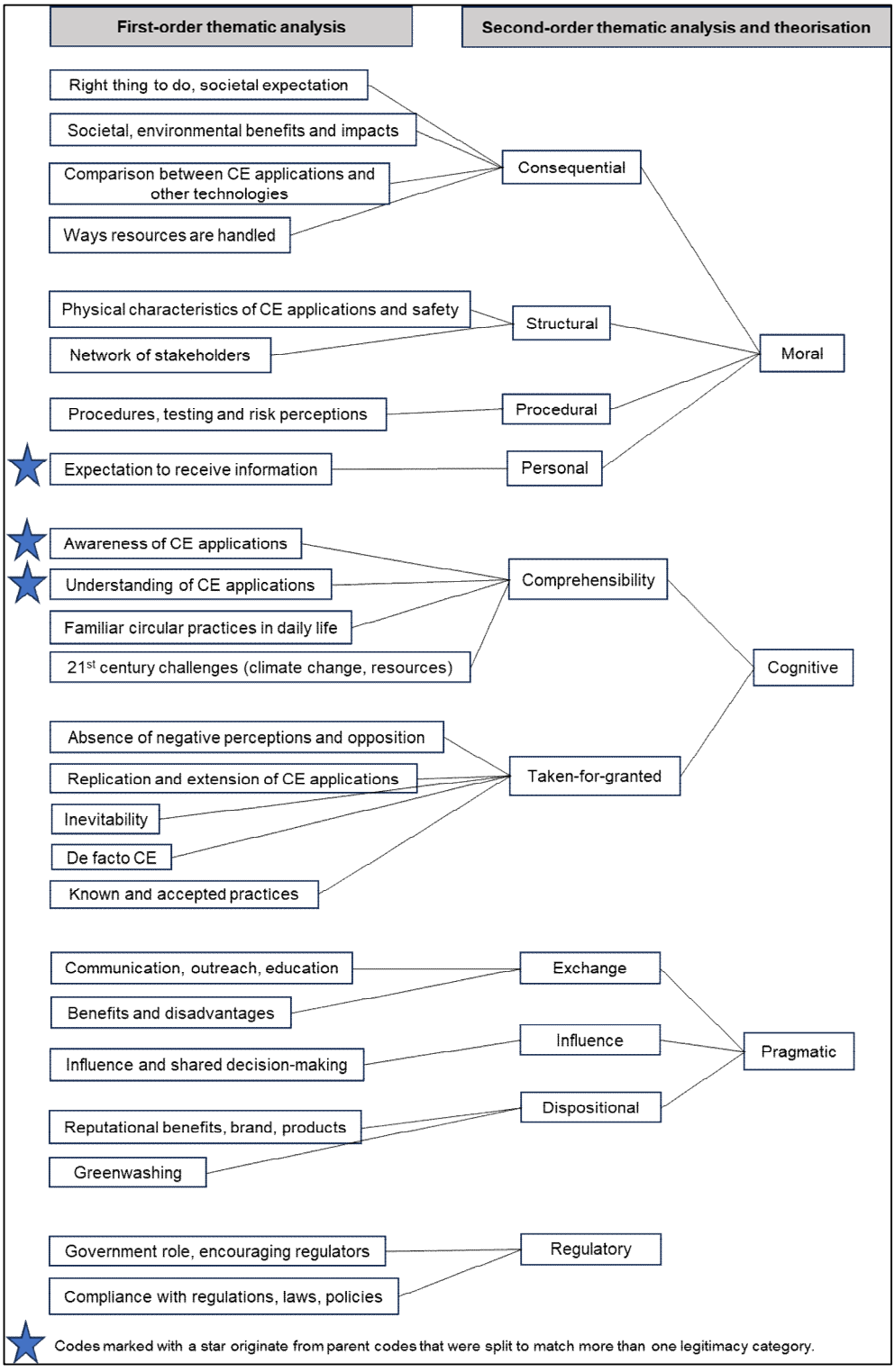


Figure 22 – Data structure showing the first- and second-order thematic analysis and the theorisation for public interviews

A.2.3 Illustrative quotes of the four legitimacy categories and the three cases studies for public's interviews

Table 25 - Illustrative quotes of the four legitimacy categories for the three case studies for public's interviews

Legitimacy	Interviewee's ID	Illustrative example
Moral Consequential	7	"I would like the society to move a lot more light in thinking this way that things should be more ethical […] there should be more sort of resourceful […] it's like a way of viewing manufacturer or production, less harmful way."
	9	"Then we are reducing our reliance on freshwater."
	1	"[…] a better impact on the environment […] you are preventing the environment getting as bad as it could get."
	6	"[…] what environmentally does it emit, […] any gases […] during the process, is there anything bad for the planet […]."
	9	"[…] is far better than burning fossil fuels and it is not as good as producing energy from wind or solar energy because obviously there are going to be some waste products."
	2	"It [sludge] is actually more natural than it would be with something that you put on the fields like pesticides which are unnatural."
	9	"It [sludge] is an organic fertilizer so it is better for the soil."
Moral Structural	8	"Obviously people like the local authority, environmental agencies, national government, of course, to set a general plan, but certainly this would be more like a local authority and planning, it will be Environmental Agency […] would be involved in [CE applications] and businesses as well, obviously, because they're the ones that will be producing them."

Legitimacy	Interviewee's ID	Illustrative example
Moral Structural	9	"I think a lot of other companies, perhaps initially would need government supports to initially funds. Support for funding for because obviously it is it's going to be quite expensive to set up initially."
	11	"Whether it's reducing the tax for a company that's doing this are charged are increasing the taxes for companies that aren't doing this, this is exactly the kind of thing you should do."
	3	"it's really quite crucial, […] sludge will be used in local barley fields […] I would question whether you are going to find distillery with barley fields right next to it […]."
	2	"I suppose my main concern is how actually you get rid of any dangerous chemicals in that circulation. You know, I can understand how you would get rid of harmful bacteria, but I don't know how you'd get rid of chemicals like lead or mercury or something like that."
	10	"I would trust the company to have the right systems in place where it was safe."
	9	"I think it's [treated] properly in this country."
	7	"I'd be fine […] as long as it's sort of […] manufactured safely."
Moral Procedural	1	"is it is it going to be completely pure and as good as the waters already in the ocean or into the coastal waters, or is it going to be somewhat contaminated food."
	7	"I don't know if it's going to require a lot of infrastructure changes I don't know, and so I don't know how that would be I don't know […] if the infrastructure is like damaging to the environment to create in the first place."
	8	"there would have to be controls over this, and presumably they're already our bodies, monitor the safety levels like they do with water has to be tested, and it has to be fit for human."

Legitimacy	Interviewee's ID	Illustrative example
Moral Procedural	12	"[…] that would have had undergone very strict tests before […] it has to pass food regulations etc government regulations before it can be put on sale to the public, so I would be quite confident that it was safe."
	8	"as I knew it was safe and that there were proper controls, but that's often the problem with industries, a lot of them don't have the necessary controls over them and so that would be an absolute disaster that that that companies."
Moral Personal	6	"By promoting […] if you had ambassadors that had a script"
Cognitive Comprehensibility	7	"I think it's very logical, I think it makes a lot of sense I think that' given the resources in the world that we shouldn't really just be exploiting and taking."
	3	"[…] it [CE concept] could mean anything. It is not a term that is current usage. It is not even a term that I see used in the media."
	5	"I think the circular economy's just a new name that politicians are perhaps using. And when you put new names into things, it throws people off. […] if you just say the natural recycling, I would understand that better than circular economy. As soon as you mention economy, you think of costs."
	4	"I wouldn't have any concerns, but again I think you just need to educate the consumer. So they fully understand the process."
	5	"I mean, we put horse manure or chicken manure on our gardens, so the sludge is a natural probably barley product that goes into the land."
	6	"Somebody tell me about a swimming pool that's heated from the local crematorium, I thought isn't that amazing."

Legitimacy	Interviewee's ID	Illustrative example
Cognitive Comprehensibility	8	"I think anything that we can use like naturally […] personally we've just had solar panels fitted to the house and now I'm using energy from the sun."
Cognitive Taken-for-granted	7	"In some ways you're replicating nature with this circular system, because if you take a really basic level like animals would have a poo on land and then a plant would be fertilized."
	3	"[…] distilleries have already been doing this for some time, creating local heating."
	12	"We all use water that comes from the system anyway."
	5	"I think in London you probably have recycled water. They say it goes through London about seven times or something like that, it comes back through the water system".
	3	"I assume I already am [eating vegetables grown with recovered nutrients]."
	6	"It [CE] is just essential because we are just using up all the planet's resources […] we have got to do it."
	5	"the high-quality wastewater that could be used for something else instead of just being put back into the water again […] it could be used for irrigation of land."
	2	"Every manufacturer and every system should be doing that and this will be a pilot that everybody can copy really."
	1	"A lot of companies and even people who have a lot of things in their life which they can be reused or repurposed into something else and there's often a lot of opportunities which are completely missed just because they were not explored."

Legitimacy	Interviewee's ID	Illustrative example
Cognitive Taken-for-granted	4	"Obviously, it makes perfect sense, especially after we just spoke and looked at the diagram, I think that if you want to roll this out to the UK public or beyond. You need to give direct example."
Pragmatic Exchange	5	"You would probably have a job there […] because a lot of distilleries are in very small towns."
	9	"[…] benefiting the community that they are not producing waste that someone else's taxpayers pay."
	3	"Which would be […] probably be more an expensive business in Scotland that it would be just taking fresh water."
	1	"Before they implemented this and the energy was going to come from somewhere before so I don't see how that would have a change for […] anyone sort of a neighbour of the distillery."
	2	"Would it smell or anything like that? That people would be afraid of smelling."
	5	"[…] the sludge part would help […] it's recycling to be used in the local barley fields. So the farmers in the area, if they grow… it means that we can grow barley locally instead of having to bring it in from abroad".
	10	"There is no benefit really […] it is more an indirect benefits, […] it brings in the environment."
	3	"I hope that would benefit me as a consumer in terms of cost […] what I am getting would be cheaper."
	7	"I imagine it [whisky] would be a little bit more expensive."

Legitimacy	Interviewee's ID	Illustrative example
Pragmatic Exchange	9	"The most important property is the taste of the whiskey."
	12	"it is a matter of personal taste, because of distillery makes whisky […] it would make me think more highly of the brand if I knew that is how they were operating."
	1	"[…] they are maximising efficiency of everything […] they are getting extra resources, extra energy, they are creating sludge which can help the fields […]."
	6	"[…] because people are very suspicious, aren't they […] so I think it needs quite a lot of education around it."
	7	"[…] what would be the benefits, not just for the society and the environment, but just long term and how this process can actually help to create a […] more worthwhile solution."
	4	"[…] there is different charities […] that promote this sort of things to the general public."
Pragmatic Influence	8	"We don't have an influence on the development of it […] this is just a general sort of position as a citizen."
	9	"When it comes to voting for any […] policy that does make it [CE applications] an important part of their policies."
	1	"Perhaps […] going with certain companies which are promoting this way of business."
	2	"You may need to involve… when something new is happening it's better actually to involve people, really, and then they feel it's not being forced upon them."
Pragmatic Dispositional	4	"I would feel more positive to them that they are making efforts to change their methods […] in a positive way for nature."

Legitimacy	Interviewee's ID	Illustrative example
Pragmatic Dispositional	7	"I am supporting a company that is not having such a negative impact on society and on the environment and aren't being sort of wasteful, they are actually more considered ethical in their values."
	7	"And I have started to pay a lot more products from smaller brands that are more ethical I'm switching my gas and electric is up for renewal and I paid for renewable electric anyway."
	3	"It does seem to be a rehash of the concept of green washing where companies tend to try assume green credentials for their activities."
	8	"Some companies […] claim to be environmentally conscious but they're not actually, in reality, so that it has to be careful."
Regulatory	8	"there's a raft of environmental laws and local laws, […] and then on top of that there's European legislation as well, I believe […] theoretically a lot of legislation to protect us from the damage that such systems can cause."
	10	"And I am pretty sure it must be, especially European laws, and all this other thing I am sure there must be rules and regulations."
	7	"I would be fine as long as it was carefully regulated."