All around the world: Assessing optimality in comparative circular economy policy packages

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ABSTRACT

The recent global diffusion of circular economy regulatory policy packages (CERPPs) raises questions over their extent, composition, and potential effectiveness. While research into circular economy (CE) regulation is growing, a dearth of analyses of the optimal design of CE policy packages presents a clear gap in the literature. This paper therefore surveys current waste management policy to identify the degree to which circular economy principles are being translated into public policy globally. Examining resource use and waste management policy in 60 countries, the paper first provides a snapshot of the global spread of CE policy packages. Secondly, the assessment framework is applied to three case studies of recent CE policy packages from Finland, Greece and South Korea. These cases fall some way short of theoretical optimality, suggesting that long-term CERPP effectiveness is questionable.

1. Introduction

The circular economy (CE) is fast becoming a key concept for informing regulatory policy responses to unsustainable resource use and waste management globally. Strategic 'policy packages' (Givoni et al., 2013; Howlett and del Rio 2015), composed of multiple CE regulatory instruments, have rapidly emerged at different levels of governance: international; supranational; national; regional; and local (Benson and Monciardini 2018). Problematically, regulation can also impose significant constraints (van Eijk 2015; de Jesus and Mendonca 2018; Kirchherr et al., 2017). Determining the degree to which a CE regulatory policy package (CERPP) can be determined 'optimal' is therefore complex and dependent on how multiple instruments interact, both with each other and with the broader policy environment. Recent developments in public policy research have enabled the normative characterization of 'optimal' policy package design (Howlett and del Rio 2015; Howlett and Mukherjee 2018). However, such approaches have yet to be applied to CE regulation and understanding of CERPP design remains limited. It is therefore timely to comparatively assess optimality of contemporary CE regulatory policy packages to provide an indicator of future effectiveness and to guide design options.

While CE policy diffusion is evident at all levels of governance, innovation has been most active at the national scale, providing a role for comparative study. Modern CE conceptions have their origins in closed-loop economy arguments of the 1970s (Stahel and Reday 1977). These ideas proved influential with policymakers, who adopted them in waste management and resource use regulatory policy (Fitch-Roy et al., 2020). Concepts such as integrated waste management (IWM) and 3R (Reduce, Reuse, Recycle), that support the waste hierarchy, then emerged to guide national regulatory responses (Seadon 2006; Sakai et al., 2011). Dedicated circular economy regulatory policy packages are more recent, with the earliest adopted in China under the Circular Economy Promotion Law 2008 (Su et al., 2013). Many national governments have since implemented strategic policy measures based upon circular economy principles, for example South Korea's Framework Act on Resource Circulation 2016. Despite such a diffusion of CE policies, comparison of national cases has been largely descriptive (e.g. McDowell et al., 2017; Lee and Cha 2018), with little theoretical

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examination of the optimality of designs. These emerging national examples therefore provide an empirical basis for comparative national analysis, an established approach to examining policy package design (Howlett 2014).

This paper sets out to survey current waste management policy to identify the degree to which circular economy practices are being translated into public policy globally, and to critically examine key examples of circular economy policymaking. Firstly, we outline the analytical approach to defining and assessing the optimality of packages of circular economy policy measures. Secondly, we apply the approach to categorise waste management policy packages in 60 nation states, identifying those that meet CERPP criteria. Thirdly, we select from this sample of CERPPs three case studies for more detailed analysis: Finland, Greece, and South Korea. Fourth, we analyse these examples to assess optimality of design against the framework established in section 2. Finally, we reflect on the research implications for achieving the CE through future policy design.

2. Assessing design optimality in package design: an analytical framework

In this section, we undertake three sequential steps to derive a framework for comparative analysis of CERPP design optimality. Firstly, we draw on the CE literature to develop a conceptualisation of circular economy, distinct from other approaches to waste management. Secondly, we apply insights from the policy studies literature to develop a functional definition of circular economy regulatory policy packages for comparison. Finally, we develop an analytical framework for assessing the optimality of CE regulatory policy packages.

2.1. Specifying the circular economy

For meaningful comparative analysis, concepts must be clearly specified to overcome the 'travelling problem' of 'stretching' over geo-political space to accommodate difference, thereby leading to 'losses of connotative precision' (Sartori 1970: 1035−1036). The problem is significant when meaningful comparison requires 'functional equivalence' between institutional structures in different political contexts (see Fitch-Roy 2016). Defining the conceptual terms of comparison is therefore necessary to comparative analysis (Peters 1998). Problematically, accurate conceptualisation is complicated by the lack of academic agreement on precisely what constitutes the circular economy (Korhonen et al., 2018a,b). To develop a definition of the CE that 'travels' comparatively, a review of the circular economy literature is required to identify salient conceptual features.

The circular economy can first be distinguished from other resource use and waste management concepts by examining the aims, objectives, targets and instruments of policy packages. In *basic waste management* (BWM), waste management does not link to resource use and endorses a linear approach with basic public service waste collection and processing provision through land-filling or open burning, with no formal measures for recycling or reducing. Limited linkage between waste management and resource use is evident in *integrated waste management* (IWM). According to UNEP (1996: 3), IWM is 'a framework of reference for designing and implementing new waste management systems'. Here, IWM is aimed at the 'direct' effects of waste management, such as collection and treatment of wastes, and the 'indirect' effects including subsequent use of wastes (Seadon 2006: 1328). While less 'linear' than BWM, IWM is still focused primarily on waste management with recycling and recovery secondary to this main process. Moving along the policy continuum towards greater

circularity, *3R/4R* or *waste hierarchy* policies explicitly link waste management to reduction, reuse, recycling, and recovery, with a typically strong emphasis on promoting recycling of materials (ibid.). *Circular economy* packages, in contrast, include aims, objectives, targets and instruments endorsing circular economy principles.

What, precisely, these CE principles constitute is contested. Numerous conceptualisations of the CE are evident in a lively if not chaotic contemporary discourse, which Kirchherr et al. (2017: 228) refer to as the 'circular economy babble'. A plethora of academic studies have recently critically reviewed the circular economy to trace its evolution, define its essential features and offer normative visions of its implementation (Ghisellini et al., 2016; Kirchherr et al., 2017; Hobson and Lynch 2016; Winans et al., 2017; Geissdoerfer et al., 2017; Reike et al., 2018; Hobson, 2020; Kalmykova et al., 2018).

In their detailed analysis of the 'babble', a critical distinction is made by Kirchherr et al. (2017: 227) between 'ideal' conceptions of the circular economy, and conceptions in which it is "… subverted to the cause of continuing an unsustainable business-as-usual model". In particular, they warn that definitions that do not explicitly assert a waste hierarchy with 'reduce' at its apex, while more palatable to some, may lead to implementations that provide incremental improvements rather than the fundamental change implied by an 'ideal' CE. This distinction rests partly on an assertion that CE implementation without strong emphasis on reducing, the 'rebound effect' (Jevons, 1865) may partially or fully offset the environmental gains of an increase in resource efficiency (such as that resulting from using resources more circularly) through unintended growth in consumption (Korhonen et al., 2018a,b; Zink and Geyer, 2017: 595; see also Makov et al., 2018). Accordingly Kirchherr et al. (2017: 229), define the ideal CE as 'an economic system that replaces the 'end-of-life' concept with *reducing*, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes' (authors' italics). In contrast, definitions adopted by many practitioners do not refer to the primacy of reducing in the circular economy. For example, the Ellen MacArthur Foundation (2019) refers to a CE that:

"… aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system … It is based on three principles: design out waste and pollution; keep products and materials in use; and regenerate natural systems."

In order to enable an evaluation of CE regulatory policy against the aims of the CE concept, we therefore argue that the minimum fundamental and distinctive functional characteristics of CE from this discursive 'babble' should include:

(i) a new economic model that enables;
(ii) a shift from linear to circular economic activity which is;
(iii) based upon principles that include *at* least reusing, recycling, and recovering, but *ideally* a hierarchy of waste in which reducing is prioritised.

These features of the CE can be combined with policy package conceptualisation to develop a definition of a circular economy regulatory policy package (CERPP).

2.2. Packaging circular economy regulatory policy

The circular economy, it is argued, will not be achieved through isolated measures alone, and will require a 'holistic approach' to policy making that involves multiple concurrent interventions (Jönbrink et al., 2019; Fitch-Roy et al., 2020). Here, we can refer back

to terms such as a 'policy mix', which first emerged to describe the combination of monetary and fiscal policy (Mundell 1962), before its wider uptake among public policy scholars (Flanagan et al., 2011). Several analogous concepts now describe policies that encompass multiple instruments, including 'policy bundles' (Milkman et al., 2012), 'policy portfolios' (Doremus 2003; Howlett and Rayner 2013) and 'policy packages' (Givoni et al., 2013). Although these terms are often used interchangeably, Howlett and del Rio (2015: 1233) argue that packages are characterized by multiple policies, goals and instruments and ' … typically involve much more than functional logics linking tools to a goal but also deal with ideological or even 'aesthetic' preferences in tool choices and goal articulation'. Others have sought to consider the co-evolutionary processes by which mixes of policy instruments emerge, develop and interact within their political and techno-logical context (for example, Flanagan and Uyarra 2016; Rogge and Reichardt 2016). This view of policy packages as emergent, contingent phenomena rather than consciously designed tools challenges the concept of 'optimality', or at least optimisation.

However, it is possible to draw on previous research to identify characteristics of policy packages associated with overall effec-tiveness or the "expedient operative influence of an intentional policy intervention upon a corresponding policy objective" (Givoni et al., 2013: 2). Optimality here is closely associated with, but distinct from, effectiveness (Brainard 1967). While policy effec-tiveness of a single instrument can be measured (albeit, *ex post*), the notion an optimal policy package implies trade-offs between multiple goals and/or instruments. Optimality then is not a "… generic quality, but rather the outcome of a sound diagnostic of the relevant policy context resulting in effective policy design" (Bouma et al., 2019: 41). In addition to comparing goals and outcomes, the task of the analyst, therefore, is to discern which elements of the policy context are optimally relevant, and how they may relate to effectiveness.

It is common to represent instrument selection as occurring within a hierarchy in which specific, detailed and implemented instruments are nested within several 'levels' of increasing abstraction. For example, Hall (1993: 278) sets out three variables: 'the overarching goals that guide policy in a particular field, the techniques or policy instruments used to attain those goals, and the precise settings of these instruments.' Similarly, Howlett (2009) develops a model in which instruments are nested within a pol-icy regime in which objectives are determined within a broader level of governance arrangements at which more general aims are enforced.

To ensure 'functional equivalence' between packages, we therefore specify that a CERPP should include the following multi-level characteristics. Rather than contain a single instrument, it should encompass multiple instruments within an overall scheme. Here, instruments include legal compulsion, market-based,[1] infor-mational, voluntary and institutional tools (Jordan et al., 2012) for supporting the CE. It is also clear from previous research that an effective CE policy mix must address the entirety of the product life-cycle (Milios 2018). Within the context of the CE globally, such packages can therefore include multi-tool strategies, plans, road-maps and framework legislation (Benson and Monciardini 2018). Differentiating such a package, we also propose two other charac-teristics operating at the hierarchical levels of policy aims and ob-jectives, which must endorse CE principles, in addition to specific implementing instruments. These are the explicit reference to circularity as a policy aim, and objectives that address the entire

Policy aims	Explicit endorsement of the principles of the circular economy as the primary policy aim, as opposed to pre-existing concepts, e.g. IWM, 3R, and, ideally, an explicit heirarchy of waste
Policy objectives	Inclusion of objectives and targets that support CE principles at the micro, meso and macro level across production, distribution, consumption
Specific implementing instruments	Inclusion of multiple policy instruments that address CE principles

Fig. 1. Functional specification of CERPP.

product lifecycle. Fig. 1 sets out the specification.

2.3. Analysing optimality in CERPPs: coherence and layering

The literature on policy mixes has diversified significantly. Within what Howlett et al. (2015: 291) call the "new policy design studies", scholars have inter alia examined: policy mix evolution (Schmidt and Sewerin 2018); regulatory instrument choice (Grabosky 1994; Gunningham and Young 1997); taxonomies of policy mixes (Howlett and del Rio 2015); the degree of policy packaging (Kern et al., 2017); and the potential of policy mixes for supporting sustainability (Rogge and Reichardt 2016). Others have turned their attention to the effectiveness of package designs, pri-marily by focusing on constituent regulatory instruments or tools (Gunningham et al., 1998; Campbell et al., 2004; Howlett and Mukherjee 2018).

Rogge and Reichardt (2016) develop a broadly applicable framework for understanding policy mixes in which the *charac-teristics* of a policy mix are considered alongside policy *strategy* and policy *processes*. In this contribution we consider two particular features of CERPPs to assess optimality: *policy coherence*, an important characteristic related to the policy process, and *institu-tional layering*, an indicator of the extent to which genuinely new policy structures have been created, something that is generally required in order to avoid the pitfalls of what Kirchherr et al. (2017: 227) describe as a 'subverted' conception of the circular economy.

2.3.1. Coherence
Several normative arguments are presented on the deployment of package instruments (ibid.; Howlett and del Rio 2015). The de-gree to which instruments complement each other in meeting policy objectives is an important factor (e.g. Gunningham et al., 1998; May et al., 2005; Benson and Lorenzoni 2016). Effective-ness, it is argued, can be impacted where there are significant in-consistencies in 'tool complementarity' (Howlett and del Rio 2015: 1234). This complementarity within policy packages may been seen as the internal *consistency* of constituent instruments (Rogge and Reichardt, 2016).

Coherence, on the other hand, can be seen as the complemen-tarity across the policy environment that "… systematically reduces conflicts and promotes synergies between and within different policy areas to achieve the outcomes associated with jointly agreed policy objectives" (Nilsson et al., 2012: 396; see also Rogge et al., 2017; Benson and Lorezoni 2016). Coherence therefore, is a broader term that reflects a policy *process* in which there is adequate consideration of synergies between policy fields and governance levels (Rogge and Reichardt, 2016: 1627). The impli-cation for the present study is that its absence, or *in*coherence, is unlikely to result in effective policy outcomes.

2.3.2. Layering
Debate has also ensued between scholars over whether

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[1] Market based instruments (MBIs) include government taxes, subsidies and financial incentives.

effectiveness is correlated with institutional 'layering' (Thelen 2004; van der Heijden 2011), where new tools are adopted alongside pre-existing instruments. Studies argue that adopting completely new packages of tools i.e. 'packaging' is more effective than independent multiple individual instruments (Givoni et al., 2013). Path dependency can, however, constrain the ability to innovate for new or changed policy objectives (Wilsford 1994). A related factor is the extent of duplication of instruments in meeting objectives, with overlap and redundancy considered constraints on the effectiveness of designs (Howlett and Mukherjee 2018).

While we acknowledge that 'brand new' policy packages may be politically and economically challenging to deploy (explaining their rarity) and are not a *panacea* (Givoni et al., 2013: 17), we also expect CERPPs displaying a high-degree of layering to represent incremental change rather than substantial reform or innovation. Layering is particularly salient given that incremental development of policy packages does not appear well suited to the complex, new challenges to which CERPPs are intended to tackle (Fitch-Roy et al., 2020). In other words, incremental CERPP development may also be associated with a 'subverted' conceptualisation of the circular economy (Kirchherr et al., 2017). Given the fundamental reordering implied by the conception of an ideal CE, it is assumed that most countries will require substantial new policy. However, the scale of innovation is somewhat dependent on the starting point. Where previous policy innovation is more compatible with CE, layering and patching of existing institutions may deliver something closer to optimality than if that were not the case.

2.3.3. Assessment matrix

These normative arguments allow the development of analytical framework for assessing optimality in CE package designs (Fig. 2). External policy coherence can be measured in various ways (May et al., 2005, 2006; Gomar et al., 2014; Benson and Lorenzoni 2016). We adopt the approach of Benson and Lorenzoni (2016) to examine the degree of external coherence between strategic policy aims, objectives, target setting, and implementing instruments. Coherence is considered low where little or no integration exists between policy packages and cognate sectoral policy. For the CE, it is particularly important that packages coordinate with strategic economic and industrial policy since these sectors dictate shifts from linearity to circularity (Fitch-Roy et al., 2020). Conversely, external coherence is high where strong interrelationships exist with such policy sectors (Benson and Lorenzoni 2016).

Layering can be assessed by examining the essential 'novelty' of policy aims, objectives/targets and instruments (Fitch-Roy et al., 2020). Where they are introduced *de novo* or 'packaged' (ibid.), layering is low. However, where they are incrementally 'patched' (ibid.) onto pre-existing measures or adopted alongside them, then layering is high.

In the 2 × 2 matrix (Fig. 1), if coherence is low and layering high then non-optimality of CERPP design may be assumed, since,
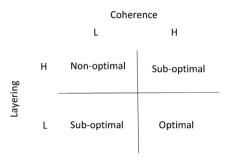
theoretically, they will impact long term effectiveness: in this case, achieving the circular economy. Conversely, if external coherence is high and layering low, then optimality is enhanced. Effectiveness is most likely where dedicated CE policy packages, which are integrated into cognate policy sectors, are adopted to replace rather than overlay or duplicate pre-existing regulatory structures. Sub-optimal design outcomes are, however, possible due to low external coherence of packaged measures but also instruments that are layered onto or duplicate existing policy.

2.4. Methods

The following comparative analysis is the result of a two-stage methodology. First, we draw upon data from a web-based documentary search of national level resource and waste management policies conducted between June 2018 and January 2019, to identify CE policy packages (Benson and Monciardini 2018). In total, we surveyed 60 countries selected first by a purposive assessment of variety within the sample, with diverse examples drawn from different political systems and levels of economic development, and secondly for availability of appropriate information (see Etikan et al., 2016). The results of the nonprobability sampling is provided in Appendix 1. Data were collected for each country on: the political system; government; responsible implementing institutions for resource use and waste management policy; main regulatory policy strategies; specific regulatory instruments; policy targets and indicators; plus, contextual data on policy development (Benson and Monciardini 2018). Documentary data were derived from official government websites, supplemented with academic studies. Secondly, this preliminary survey uncovered a sub-set of CERPPs for in-depth analysis. A multiple case study design then allowed direct comparison between national examples. Further documentary data was collected on each national policy to determine its political context, historical evolution and characteristics.

3. Circular economy regulatory policy packages: general trends

The cross-national survey shows several general trends, divided into package types and geo-political distribution. In respect of the former, policy packages cluster into those that meet the criterion of the CERPP conceptualisation and other forms of resource use and waste management policy. Analysis of geo-political distribution shows that CERPPs are concentrated in Europe, with notable exceptions in Asia and South America. In addition, CERPPs are generally recent additions to pre-existing resource use and waste management policy.

3.1. Package types

Very few countries in the sample meet the CERPP specification developed above (Table 1). Package types ranged from simple waste management policies, supporting a linear economy approach, to those based on CE principles.

Data analysis reveals some specific trends regarding package types. A limited sub-set of national packages contained instruments that endorse a BWM linear approach. Where recycling does occur it is conducted by an unregulated and informal private sector. One example is Kyrgyzstan, where government policy is implemented by long established waste management legal frameworks. Under this approach, solid, household and hazardous waste is typically landfilled rather than incinerated or recycled (UNCRD 2018). A similar situation is evident in Gambia, where municipal solid waste collected is generally landfilled without processing (see Sanneh et al., 2011).

Fig. 2. CE regulatory policy package assessment matrix.

Table 1
Policy package types and national policy packages.

Policy package type	Policy package characteristics	Typical policy instruments	Number of countries[a]
Basic waste management	No linkage between waste management and resource use	Basic provision for public service managing of wastes through landfilling or burning	7
Integrated waste management	Limited linkage between waste management and resource use	Collection and treatment of wastes, some limited usage of wastes	22
3R/waste hierarchy	Strong linkage between waste management and resource use	Implementation of the waste hierarchy (reduce, recover, recycle) in resource use and waste management	21
Circular economy	Complete integration of waste management and resource use	Reducing waste and pollution through design, maintaining materials in production and consumption cycles through reusing, recycling and recovering.	10

[a] From a sample of 60 states (Appendix 1).

The majority of national policies contained some 'circular' instruments for reducing or recycling but were based primarily on *integrated waste management* principles. For example, Kenya is a progressive CE innovator, through its Nationally Appropriate Mitigation Action (NAMA) on a Circular Economy Municipal Solid Waste Management Approach for Urban Areas policy (UNDP 2017). However, its ban on plastic bag use (2017) aside, the NAMA primarily encompasses waste collection and recycling policy instruments rather than a holistic CE approach. Costa Rica regulates wastes under the Costa Rican Integrated Waste Management Law 2010 (Government of Costa Rica, 2010). Municipalities are obligated to manage wastes but urban waste is typically landfilled while in rural areas it is burned or dumped. Community-led initiatives are however emerging to tackle waste problems, particularly through payments for ecosystems services (PES), eco-labels and certification.

Indeed, there is increasing policy innovation around CE policy instruments in non-Western contexts. Notable examples include regulatory bans on plastic bag use in Kenya and Rwanda (Government of Rwanda, 2008), the world's first ban on single use plastics in Vanuatu in 2018 (Government of Vanuatu, 2018), e-waste management strategies in Uganda (Government of the Republic of Uganda, 2013) and Rwanda, Costa Rica's Ecolones system of virtual recycling, and an innovative education programme for promoting alternatives to plastic bags and environmental products in Morocco.[2] Newly industrializing countries may consequently be 'leapfrogging' (Soete 1985) industrialized states in regulatory policy.

In East and South East Asia the historical legacy of *3R* policies, promoted by ASEAN (Association of South East Asian Nations), has led to national policy packages endorsing waste hierarchy (reuse, recover, recycle) principles. Examples include Indonesia, Vietnam, Thailand, India and Singapore. The latter has a progressive 3R policy package, the Singapore Waste Minimisation and Recycling Policy. Innovative implementing tools include market-based instruments such as the '3R Fund' to encourage waste minimisation and support recycling projects (NEA, 2018). However, the most sophisticated example of a 3R policy package comes from Japan. The Basic Law for Establishing a Sound Material-Cycle Society 2000 and associated Fundamental Plans have sought to integrate 3R principles across society through comprehensive waste management and recycling measures (Sakai et al., 2011; Yoshida et al., 2007). The current Japanese Fundamental Plan 2018 promotes a sound material-cycle society through extensive recycling laws, reducing landfilling and restricting waste production.

EU states, meanwhile, have implemented *waste hierarchy* principles through Community waste legislation, primarily the Waste Framework Directive.[3] This Directive specifically requires that the waste hierarchy must be applied in waste management policy. The UK, for example, implements the EU legislation through its Waste (England and Wales) Regulations 2011, which obliges local authorities to adopt waste management plans. Extended producer responsibility (EPR) for wastes is also required by the EU Packaging and Packaging Waste Directive 1994 and the Waste Electrical & Electronic Equipment (WEEE) Directive 2012. Some EU states, meanwhile, have adopted strategic policy packages for implementing the waste hierarchy through promoting resource efficiency, for example Austria's Resource Efficiency Action Plan (REAP) 2012 (BMLFUW 2012).

Fewer countries have adopted policy packages that explicitly endorse *circular economy* principles (Table 2). The first recognisable CERPP was China's Circular Economy Promotion Law 2008, which sets the national regulatory framework for circular economy policy instruments (Su et al., 2013; Mathews and Tan 2011). Primarily, it legally compels provinces to adopt plans for recycling and recovery. China's Circular Economy Development Strategies Action Plan 2013 also outlines targets for 2020. Denmark is another 'pioneer' in strategic policy innovation with its adoption of the National Strategy for the Circular Economy 2013 (The Danish Government 2018). Another significant innovation came in 2014 with Colombia's Green Growth Mission (Mision de Crecimiento Verde: Department of National Planning 2019). In Europe, the emergence of national CE regulatory policy packages has accompanied the EU Circular Economy Action Plan 2015, updated in 2018 and again in 2020 (European Commission 2019, 2020). Notable examples in the intervening period are the Netherlands Circular Economy Programme, Finland's 'Leading the Cycle' policy and South Korea's 2016 Framework Act on Resource Circulation. Among the recognisably circular policy packages, only three explicitly invoke in their strategy documents or framework legislation the concept of the hierarchy of waste identified by Kirchherr et al. (2017) as a necessary but challenging requirement for an ideal-type CE: China, Greece, and South Korea.

3.2. Geo-political and temporal distribution

The survey sample also shows the geo-political distribution of policy package types. Basic waste management policies were associated with countries with low GDPs, primarily in Africa and parts of Asia and Central America. The majority of integrated waste management (IWM) policy packages are in newly industrializing states. Indeed, some policy packages identified explicitly focus on integrated waste management despite the adoption of some innovative CE regulatory instruments. As identified above, 3R and waste hierarchy packages tend to be distributed across

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[2] Under the Programme National des Déchets Ménagers - National Household Waste Program (PNDM) (2017−2021).

[3] Directive 2008/98/EC.

Table 2
National CE regulatory policy packages (CERPPs).

Country	Main regulatory policy document(s)	Year of adoption	Explicit waste hierarchy
China	Circular Economy Promotion Law 2008 (amended 2018) (Government of the People's republic of China 2008; 2018)	2008	Yes
Colombia	Green Growth Mission − Mision de Crecimiento Verde (Government of Colombia, 2018)	2014	No
Denmark	National Strategy for the Circular Economy (Government of Denmark, 2018)	2013, 2018	No
Greece	National Circular Economy Strategy National Action Plan on Circular Economy (Government of Greece 2018; 2019)	2018	Yes
Finland	Leading the cycle: Finnish road map to a circular economy 2016−2025 The critical move: Finland's roadmap to the circular economy 2.0 (Sitra 2016, 2019)	2016, 2019	No
France	Circular Economy Roadmap of France: 50 measures for a 100% circular economy (Government of France, 2018)	2018	No
Netherlands	Circular Economy Programme (A Circular Economy in the Netherlands by 2050) (Government of The Netherlands, 2016)	2016	No
Portugal	Green Growth Commitment (Government of Portugal, 2015)	2015	No
Slovenia	Roadmap towards the Circular Economy in Slovenia (Government of Slovenia, 2018)	2018	No
South Korea	Framework Act on Resource Circulation 2016 (amended 2018) (Government of South Korea, 2018)	2016, 2018	Yes

industrialized states, with the former prevalent in ASEAN members and the latter characteristic of EU countries.

The survey identified 10 CERPPs from the sample, including examples from China, Finland, Denmark, Netherlands, Portugal, Austria, Slovenia, Greece, France, South Korea and Colombia (Table 2). The influence of circular economy principles on national strategic direction is a recent phenomenon. Of the states with recognized packages, China was the first to adopt its policy in 2008 followed by Denmark in 2013, Colombia 2014, Government of Portugal (2015), South Korea 2016, Netherlands 2016, Finland 2016, and Greece, France and Slovenia in 2018. With notable exceptions aside, most are associated with industrialized, high-income economies.

4. Case studies

Three CERPPs were selected from the ten examples found for in-depth analysis. The selection strategy is based primarily on maximum variation, with cases drawn from both Europe and Asia, as well as from nations with a strong history of innovation in waste management regulation and others that have tended to lag behind their peers in this domain. We also selected cases with and without explicit reference to waste hierarchies in their published CE strategy. Finland presents a key example of innovative CE policy, although it does not invoke a waste hierarchy, while Greece is a country that has consistently experienced problems with implementing waste management policies meaning that its CE package, that does refer to a hierarchy of waste, represents an important innovation. Finally, South Korea, nominally at least, is presented as an important innovator in circular economy policy.

4.1. Finland: leading the cycle: Finnish Road Map to a circular economy 2016−2025

4.1.1. Context

Finland provides an innovative, globally leading example of an integrated circular economy policy strategy that originates in earlier initiatives. Current national measures date back to the 'Getting More and Better from Less' 2005 policy for sustainable consumption and production, updated in 2012. This policy employed different levels of government to generate sustainability solutions, promote smart energy, reduce food waste and increase environmentally sustainable transport. A 'Natural Resource Strategy for Finland: using natural resources intelligently' was then published in 2009, followed by three sector-specific resource use strategies for materials efficiency (2013), real estate and construction (2012) and bio-economy (2014). They preceded an integrated CE policy, set out in the 2015 Strategic Programme of Prime Minister Sipilä's Government. The Programme specifies measures for achieving a circular economy, including reducing nutrient loss, increasing recycling and prohibiting landfill of waste. Accordingly, a National Waste Management Plan 2016 'Towards a recycling society' was introduced in 2016, alongside a National Waste Management Plan and Waste Prevention Program 2016−2030 in 2017. In addition, 'Leading the cycle: Finnish Road Map to a Circular Economy 2016−2025' was published in 2016, after consultation with stakeholders.

4.1.2. Policy overview

The Road Map seeks to assure Finland's global leadership in implementing the circular economy, through targeting five areas: '1) a sustainable food system 2) forest-based loops 3) technical loops 4) transport and logistics and 5) joint actions' (Sitra 2016: 3). The road map does not explicitly refer to a waste hierarchy, although the technical loops do aspire to 'no more unnecessary goods' (*ibid*: 22). Specific recommended policy actions are detailed for each target area. To achieve policy coherence, a Circular Economy Steering Group was established as an advisory body for the period 2017−2019, comprised of multiple stakeholders charged with ensuring cooperation on CE implementation.

Finland then adopted an Action Plan for a Circular Economy in November 2017 'to promote the realisation of the circular economy' (Sitra 2017: 1). The plan proposes three types of instrument: public procurement; new products and service innovations; and platforms for CE experimentation. A key instrument for innovation is reducing regulatory barriers to the CE through a 'one-stop-shop' for business licensing and 'voluntary contractual models' for materials and energy efficiency. Another instrument listed is public procurement, with new financial instruments for central and municipal governments (ibid.). The Action Plan also identifies promotion of new business models such as digitalisation and urban CE initiatives, along with a business network for CE support and educational instruments for CE skills creation and citizen information provision.

In 2019, an updated version of the Road Map featured additional measures (Sitra 2019). The Road Map '2.0' expands the policy scope to four strategic goals: achieving circular economy solutions that support national economic competitiveness; transitioning to low-carbon energy; promoting sustainable use of natural resources; and reducing individual carbon footprints. It establishes thirteen actions to support policy implementation. Here, targets and instruments are specified, including integrating the CE across

government ministries, giving the Circular Economy Steering Group long term official status and increasing taxes on environmental impacts (Sitra 2019). The draft was made publicly available for comment, with input provided by the Circular Economy Steering Group.

4.2. Greece: National Action Plan on Circular Economy 2018

4.2.1. Context

The National Action Plan on Circular Economy marks a qualitative shift away from linear waste governance in Greece. In 2004, the European Court of Justice (ECJ)[4] found that Greece had breached obligations under the EU Waste Framework Directive requirements to close landfill sites. The European Commission then referred Greece to the Court again for 'persistent poor waste treatment' (European Commission 2015). Under EU pressure Greece introduced a National Plan for Waste Management 2015−2030, although it focused primarily on improving the existing waste management rather than circularity. A related legislative measure, the Law on Recycling, entered force in 2017 along with a Ministerial decision on plastic bag charging. After wide consultation, the Greek Economic Policy Council published its National Action Plan on Circular Economy in 2018 (Hellenic Republic Ministry of Environment and Energy 2018).

4.2.2. Policy overview

The Action Plan sets out long term aims for national resource and waste management policy, objectives/goals and immediate priority actions. A specific aim is to 'accelerate circular economy actions and unlock potential growth' (Hellenic Republic Ministry of Environment and Energy 2018: 4). Long-term goals set out by the Greek government include an explicit hierarchy of waste in which prevention is prioritised (*ibid*: 11). Other objectives are to: support circular entrepreneurship; promote circular consumption through reuse, repair and restoration; develop multi-stakeholder partnerships for circular policy implementation; and monitor progress through dedicated indicators. Four priority actions intend to support movement towards these goals, each specifying different types of instruments. Ten regulatory and legislative interventions include: integrating CE principles into pre-existing enviromental impact assessments (EIA), strategic environmental assessments (SEA) and environmental permitting regulation (Hellenic Republic Ministry of Environment and Energy 2018). Policy objectives will be achieved through EUstructural and international development funds, 'circular tax incentives' and state aid provision (ibid.). Informational tools include awareness raising and communication initiatives (ibid.). Finally, new institutional tools or 'governance actions' include an inter-ministerial Executive Secretariat for the Circular Economy and government Observatory, to oversee implementation (ibid.).

4.3. South Korea: Framework Act on Resource Circulation 2016

4.3.1. Context

South Korea has become a global CERPP innovator through adoption of the Framework Act on Resource Circulation (FARC) (Act No. 14229, May 29, 2016). South Korea has steadily progressed from linear modes of resource and waste management regulation to endorsing circular economy principles in national policy. This process began in 1986 with the Waste Management Act, which encompassed both household and industrial waste through reduction, recycling, disposal and final treatment of wastes (Lee

and Cha 2018). The shift towards greater circularity is evident in the Act on Promotion of the Saving and Recycling of Resources (1992). An explicit aim, specified in Article 1, is national economic development through control of waste generation and facilitation of recycling. Recycling of resources is as a basic legal obligation, along with application of the waste hierarchy (Article 2). Specific implementing instruments include: the production of multi-annual national waste Master Plans; regulatory controls on packaging wastes; waste charges; and extended producer responsibility. A Mandatory Recycling Ratio for packaging and product recycling was also established. Subsequent sector-specific legal measures included Acts for waste treatment facilities (1995), construction waste recycling (2005), and electrical and electronic equipment (2008). The circular economy is stated as a fundamental aim of policy thereby marking a change in waste management conceptualisation. The Ministry of Environment (2018) therefore refers to a 'paradigm shift of waste management policy'.

4.3.2. Policy overview

The FARC comprises three main sections. Chapter 1 provides the general provisions of the Act. These include the explicit aim for 'creating a sustainable resource-circulating society' through resource efficiency and 'promoting circular utilization' and treatment of wastes (Article 1). Among the 'basic principles' laid out in the Act (article 3), a clear hierarchy of waste is explicated. Chapter 2 sets out policy objectives and administrative arrangements. The Ministry of Environment is required to formulate and implement a Master Plan for Resources Circulation, setting medium to long term policy objectives and targets (Article 11, (2)). Administrative responsibilities for implementing the Plan are identified, along with a provision to conduct statistical surveys on its application. Chapters 3 and 4 outline regulatory, fiscal and informational policy instruments that include: a product Quality Mark Certification for Circular Resources; waste disposal charges for landfilling or incineration of wastes that can be 'circularly utilized'; waste disposal charge hypothecation measures; Resources Circulation Special Accounts for local authority expenditures; a Circular Resources Information Center; government loans for local authority resource-circulating projects; and international cooperation.

5. Theoretical nanalysis and discussion

The three CERPP case studies adopt different policy approaches to circular economic transformation. Assessing their implementation effectiveness remains pre-emptive but, we can nonetheless examine the optimality of designs from a theoretical perspective, as an indicator of future effectiveness of CERPP design.

5.1. Optimality of designs

As described in section 2, optimality is an assessment of the coherence of instruments, both internally and externally, and the degree of layering versus 'packaging'. The case studies show different degrees of (sub) optimality. Finland has introduced some genuinely new instruments via the Finnish Road Map, i.e. packaging. Innovations in the Action Plan include commitments to new financing instruments for public procurement, 'impact investing' and 'social impact bonds', with the intention of creating 'Europe's first EIB, or environmental impact bond' (Sitra 2016: 2). Through CE teaching in schools and universities, Finland aims to train 60,000 experts, putting the country at the forefront of CE implementation globally.

External coherence with other policy sectors is addressed through 'mainstreaming' coordinating mechanisms such as the Circular Economy Steering Group. This multi-stakeholder body is

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[4] ECJ Judgement No C-119/02 of 24 June 2004.

comprised of the Minister for Housing, Energy and the Environment along with representatives from inter alia the Ministry of Agriculture and Forestry, the Climate Leadership Council, the Finnish Parliament, The Chemical Industry of Finland, the Association of Finnish Local Authorities and Regional Authorities, industry groups and universities. Finnish businesses participate in policy implementation, while the five 'focus areas' cover key economic sectors: sustainable food systems; forest-based loops; technical loops; transport and logistics; common actions (Sitra 2016). The Road Map 2.0 explicitly recognises the need for mainstreaming through its actions for cross-ministerial cooperation on CE implementation, giving official status to the Steering Group and integrating sustainable development into public funding assessment (Sitra 2019). Finally, crosscutting indicators will measure Road Map implementation.

However, more detailed analysis suggests that the Finland policy package design may be less optimal. The package does promote novel economic instruments, particularly for financing circular public procurement, showing that 'packaging' may be enhanced. Yet, the Action Plan — in contrast to the Road Map — includes few actual new instruments. This partly reflects Finland's starting point as a global innovator in green public procurement, being presented as an example of best practice globally (Nissinen et al., 2009; Palmujoki 2010). Public procurement instruments could then be considered 'patching' onto pre-existing structures.

External coherence could also be questioned. The Road Map 2.0 links to national climate mitigation commitments, the national Waste Act and the UN Sustainable Development Goals (SDGs) but it does not explain integration with existing EU policy commitments for waste management. Nor does it refer to cognate strategic documents such as the National Waste Management Plan 2016 'Towards a recycling society'. No specific details are provided on the wider coherence of the Road Map with national economic or industrial policy, apart from '2.0' actions on environmental tax reform and reducing subsidies. Incoherence with other sectorial policy aims, objectives, targets and instruments may therefore occur.

Design sub-optimality is also apparent in the Greece case study. The 2018 National Action Plan design mixes new instruments with incremental adjustments or 'patching' pre-existing tools. Communication strategies, CE databases and indicators for assessing progress towards the CE are essentially new, along with the inter-ministerial Executive Secretariat and Observatory. However, integration of CE principles into existing EIA, SEA and environmental permitting measures demonstrate significant patching. Market based instruments, moreover, build primarily on pre-existing EU and state aid funding.

External policy coherence can also be questioned. The basic strategy comprises three 'pillars': Sustainable Resource Management; Support of Circular Economy; and Circular Consumption (Hellenic Republic Ministry of Environment and Energy 2018: 10). But the Action Plan only identifies the need for their incorporation with 'Governmental planning and Ministerial sectorial policies, [and] into the National Developmental Strategy 2021' (ibid.: 11). Coordination with government agencies and wider government administration is also prioritised through the Executive Secretariat for inter-ministerial coordination, the Observatory, and pre-existing inter-ministerial coordinating groups,[5] but few details are provided on how coherence will occur.

Finally, the South Korea Framework Act design could be considered more optimal in terms of its external coherence and layering but questions still remain over whether it can create a 'resource-circulating society'. The CE certification for products, special budgetary accounts for local authorities and information center instruments are specific to promoting 'resource-circulating' in the wider economy. Certainly, the FARC does then mark an innovative national policy approach in considering waste in resource use terms. In South Korea, however, waste management charges and infrastructure loans are not entirely novel, and therefore only incrementally extend previous policy measures. Critics also maintain that the policy 'does not fully integrate the entire life cycle of a product, from production to consumption, waste management, and from waste to resources' nor waste-to-energy (Lee and Cha, 1997, 2018), meaning that external policy coherence is not achieved. Indeed, Lee and Cha (ibid.) note the need:

> "… to establish a governance mechanism to fulfil Korea's commitments … to a more sustainable resource-circulating society and to enable collaboration among the different regulatory authorities."

Another aspect, not referred to in the FARC, is the implications for parallel strategic policy priorities. South Korea has promoted national policy commitments to low carbon green growth,[6] that endorse an overt ecological modernization perspective, which may be considered analogous to the circular economy but establish different policy objectives, primarily around greenhouse gas emission reductions (GGGI 2015). Their integration with circular economy policy would appear necessary to avoid incoherence.

5.2. Prospects for the CE?

The findings suggest some implications for future CE development. Scholars have questioned the ability of conventional public policy to realise the normative aims of the circular economy, primarily because they require transformative disruption to current linear modes of economic organization (Fitch-Roy et al., 2020). Our analysis suggests that existing CERPPs are unlikely to generate the regulatory conditions for such a transformational 'paradigm shift'. Policy designs exhibit degrees of instrumental layering over pre-existing policy, with some genuinely innovative approaches mixed with incremental 'patching', and do not generally mark a radical change towards circularity.

Of particular significance is the distinction between 'ideal' conceptions of the CE and those vulnerable to 'subversion' gleaned from strategy documents. From our small sample, there appears to be little connection between the radical implications Kirchherr et al. (2017) attribute to definitions that outline 'Reduce' as the CE's priority and commensurate fundamental reordering of public policy. In Greece, where 'reduce' is a primary objective, institutional innovation is less pronounced than in Finland or South Korea. This point is especially significant given the fact that, by most accounts, Greece has 'further to travel' towards sustainable waste management generally.

While it is not surprising that public policy exhibits a high degree of path-dependency, the fact that *de novo* policy packages are not emerging, even where policy is clearly informed by the undeniably radical principles of an ideal-type CE should be of concern to CE advocates. The high degree of layering observed shows that the

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[5] The Strategy records 'initial mapping of actions' for implementing the CE, including an inter-Ministerial Committee on Green Public Contracts and working groups for promoting the CE to industry, food waste prevention, national standards and 'Agro-nutrition, Manufacturing, Tourism' (Hellenic Republic Ministry of Environment and Energy 2018: 7).

[6] A pre-existing institutional framework for low carbon green growth exists in the form of the Framework Act on Low Carbon Green Growth 2010 and the National Strategy for Green Growth (2009–2050).

envelope of political and administrative possibility may not extend far enough to encompass a fully realised circular economy. In addition, limited external coherence between policies, particularly with strategic economic and industrial policy, is a concern when the circular economy will require concerted regulatory coordination.

6. Conclusions

This paper comparatively assesses the optimality of CERRP design in terms of their novelty (packaging) *vis-à-vis* layering or incremental patching of instruments and their external coherence, in relation to cognate policy. A broad based survey was undertaken to assess the diffusion of CERPPs and identify examples for analysis. The survey reveals that countries are now adopting CERPPs to supplement their pre-existing resource use and waste management policy packages. Current designs differ in optimality, when examining the novelty of instruments and the degree to which packages are externally coherent. On the above evidence, few genuinely novel packages are evident and issues may arise with external coherence. Enabling the radical transformations required to shift economies from linear to circular modes of production and consumption through system-wide change may not then be achievable through such policy packages and they appear, at best, capable of initiating incremental change.

However, the precise reasons for the sub-optimality of CE-inspired policy are not clear and it remains difficult to generalize on the basis of three case studies, thereby opening up the field for further theoretically-informed comparative research. Future investigations could be undertaken into the effectiveness of emergent CERPPs, although their newness currently precludes measurement. The degree of packaging, layering and patching of instruments is also another potential focus while external coherence could be further assessed alongside internal coherence of policy measures. A critical question for future CERRPs analysis is whether they can initiate a genuine paradigm shift in national governing towards the circular economy, as this will require fundamental changes in economic activity which 'mainstream' the CE at the highest levels of political decision-making. While our analysis clearly shows that a more 'ideal-type' conception of the circular economy is not a sufficient condition for transformative policy, it remains to be seen whether it is a necessary one. A critical role for policy analysts therefore exists in helping to understand the optimality of CE policy packages in support of such transformation.

Credit author statement

Oscar Fitch-Roy: Conceptualization, Methodology, Writing Original draft preparation; David Benson: Conceptualization, Investigation, Data curation, Writing-Reviewing; David Monciardini: Writing- Reviewing and Editing, Validation;

Data access statement

All data required to reproduce this study are contained in the results and references.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix 1. sample of national waste management and resource use policies (source: Benson and Monciardini 2018)

1	**Albania**
2	Austria
3	Bangladesh
4	Bhutan
5	Botswana
6	Brazil
7	Canada
8	China (PRC)
9	Colombia
10	Costa Rica
11	Croatia
12	Denmark
13	Estonia
14	Fiji
15	Finland
16	France
17	Gambia
18	Greece
19	India
20	Indonesia
21	Israel
22	Japan
23	Kenya
24	Kiribati
25	Kyrgyzstan
26	Latvia
27	Liechtenstein
28	Luxembourg
29	Malaysia
30	Maldives
31	Mexico
32	Micronesia
33	Mongolia
34	Morocco
35	Myanmar
36	Netherlands
37	Pakistan
38	Palau
39	Papua New Guinea
40	Philippines
41	Poland
42	Portugal
43	Rwanda
44	Samoa
45	Saudi Arabia
46	Serbia
47	Singapore
48	Slovenia
49	South Africa
50	South Korea
51	Sri Lanka
52	Switzerland
53	Taiwan
54	Thailand
55	Turkey
56	Tuvalu
57	Uganda
58	United Kingdom
59	Vanuatu
60	Vietnam

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