JUST2CE

A Just Transition to Circular Economy

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Authors Eds Renato Passaro, Patrizia Ghisellini, Mario Pansera, Stefania Barca, Martin Calisto Friant

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JUST2CE

A Just Transition to Circular Economy

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JUST2CE

A Just Transition to Circular Economy

PROJECT No. 101003491

Just2ce will assess the current state of transition towards the circular economy in relevant economic sectors and analyse possible transition scenarios, as well as their outcomes and impacts. It will identify the key factors that can stimulate or hinder this transition. Natural resources are extracted and transformed into products, which are eventually discarded. As many natural resources are finite, it is important to keep materials in circulation for as long as possible. This makes the transition to a circular economy more vital than ever, but is a responsible, inclusive, and socially just transition to a circular economy possible or even desirable? What technical, political, and social factors can enable or hamper such transformation? The EU-funded JUST2CE project will answer these questions. It will explore the economic, societal, gender and policy implications of the circular economy paradigm. The project's findings will shed light on how to ensure democratic and participatory mechanisms when designing and managing such technology.

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List of abbreviations

AATIF	African Agriculture and Trade Investment Fund
ACEA	African Circular Economy Alliance
ACEF	*African Circular Economy Fund*
ACEN	African Circular Economy Network
AFCFTA	African Continental Free Trade Area
AFDB	African Development Bank
AI	Artificial Intelligence
AIT	Austrian Institute of Technology
CBA	Cost-Benefit Analysis
CE	Circular Economy
CEAP	Circular Economy Action Plan
CEIP	Circular Economy Innovation Partnership
CGE	Computable General Equilibrium
CIW	Canadian Index of Wellbeing
CPY	Citation Per Year
CRA	Cost Revenue Analysis
CVORR	Complex Value Optimization for Resource
DDR	Declining Discount Rate
DS	Decolonial Studies
DSS	Decision Support System
E-Book	Electronic Book
EC	European Commission
ECESP	European Circular Economy Stakeholder Platform
EEIOA	Environmentally Extended Input-Output Analysis
EESC	European Economic and Social Committee

EF	Ecological Footprint
EIP	Eco-industrial parks
EJ	Environmental Justice
ELCC	Environmental Life Cycle Cost
EMA	EMergy Accounting
EMF	Ellen MacArthur Foundation
EPI	Environmental Performance Index
EPR	Extended Producer Responsibility
ESPI	European Social Progress Index
EU	European Union
EUGD	EU Green Deal
FCE	Fortress Circular Economy
FEE	Feminist Ecological Economics
FIDA	Foundation for Agricultural Development
FIRR	Financial Rate of Return
FLCC	Financial Life Cycle Cost
FNPV	Financial Net Present Value
FU	Functional Unit
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHGs	Greenhouse Gases
GI	Gendered Innovation
GMOs	Genetically Modified Organisms
GN	Global North
GNH	Gross National Happiness
GPI	Genuine Progress Indicator
GS	Global South

GVCs	Global Value Chains
IEA	International Energy Agency
ILO	International Labour Organisation
INEC	Institut National de l'Économie Circulaire
IO	Input Output
IRR	Internal Rate of Return
ISTA	Institute of Science and Technology Austria
ITUC	International Trade Union Confederation
JT	Just Transition
LCA	Life Cycle Assessment
LCC	Life Cycle Costing or Life Cycle Cost
LAWMA	Lagos State Waste Management Authority
MAI	Inner Areas Meeting
MCDM	Multi-Criteria Decision Making
MCI	Material Circularity Indicator
MEIO	Macro-Econometric Input-Output
MFA	Material Flow Analysis
MOI	Means of Implementation
MS	Member State (of the EU)
MSW	Municipal Solid Waste
NCI	Natural Capital Index
NGOs	Non-Governmental Organizations
NGEU	Next Generation EU
NPV	Net Present Value
NRBIs	Natural Resources-Based Industries
NUTS	Nomenclature of Territorial Units for Statistics

NWMP	National Waste Management Plan
NWMS	National Waste Management Strategy
NWPP	National Waste Prevention Programme
OECD	Organization for Economic Cooperation and Development
PACE	Platform for Accelerating the Circular Economy
PE	Political Ecology
PNRR	National Recovery and Resilience Plan
RCS	Reformist Circular Society
RRF	Recovery and Resilience Facility
RRI	Responsible Research and Innovation
SDGs	Sustainable Development Goals
SDR	Social Discount Rate
SFC	Stock-Flow Consistent
S-LCA	Social Life Cycle Assessment
S-LCC	Social Life Cycle Cost
SEM	Socio-Economic Metabolism
SMEs	Small Medium Enterprises
TCS	Transformational Circular Society
TIPs	Transformative Innovation Policies
TPs	Transformative Policies
TRL	Technology Readiness Levels
SDR	Social Discount Rate
SNAI	Inner Areas National Strategy
SSA	Sub-Saharan Africa
SSE	Social & Solidarity Economy

SRL	Systematic Literature Review
UBI	Universal Basic Income
UN	United Nations
UNE	United Nations Environment
UNIDO	Industrial Development Organization of the United Nations
USA	United States of America
WBSD	World Business Council for Sustainable Development
WEEE	Waste Electrical and Electronic Equipment
WEF	World Economic Forum
WLCC	Whole Life Cycle Cost
WP	Work Package
WTP	Willingness-To-Pay
3R	Reduce Reuse Recycle

INTRODUCTION

The e-book “Circular Economy for Social Transformation: multiple paths to achieve circularity” represents the third outcome of WP1 (Beyond the current CE models and practice) of the JUST2CE project. WP1 aims to provide a rigorous and comprehensive overview and analysis of the current state-of-the-art in the Circular Economy (CE) field, highlighting uneven developments, differences in theorisations, understandings and implementations between different geographical, ideological and political-economic contexts. Moreover, the eBook encompasses results and reflection elaborated in WP2, 3, 4 and 5.

This eBook aspires to be a map of ‘CE plurality’ by means of an overview of the current applications of CE in the international context with a particular focus on combining CE with theories of global environmental justice, social justice, gendered innovation and labour. The chapters of this book highlight some crucial elements to understand the key characteristics of the current complex process of initiating a transition towards the CE, the tools and frameworks for measuring CE and a roadmap to a just CE across its main concepts, geographical areas and scenarios. This helps us better analyse and understand what circular futures we can expect and what circular futures we should strive for. The majority of studies and narratives devoted to CE are embodied in the neoliberal economic model that is driven by market mechanisms and private for-profit corporations (Genovese and Pansera, 2021).

The prevailing idea of the mainstream CE is the assumption that an economy based on self-regulatory market mechanisms can work in symbiosis with the environmental system without changing power relations, politics, practices and norms (Genovese and Pansera, 2021; Calisto Friant et al., 2020). However, many empirical case studies in the international literature evidence that mainstream CE propositions do not address current social injustices (environmental, geographical, social, gender, labour) (Martínez-Alvarez and Barca, 2021; Meira et al., 2021; Thapa et al., 2021; Nagarajan, 2022; Suarez-Visbal et al., 2022; Valencia et al., 2023; Vanacker et al., 2023). A just CE transition CE should pursue shared objectives that balance social, economic and environmental considerations and should be implemented in the most equitable, participatory and inclusive way possible. A CE should ultimately aim to create greater well-being for all without leaving anyone behind. Therefore, there is a gap in the discussion about imagining a different and more just transition to CE that calls for more critical and systemic approaches to mainstream CE models and theorising a just circular socio-economic system. This e-book and the project behind it intend to contribute to filling this gap and provide the basis to build an alternative and achievable circular future in which the assumptions and the logic underlying the linear model are questioned. Indeed, without overcoming unsustainable consumption and production models, all efforts to establish a societal system compatible with the objectives of global socio-ecological well-being become sterile. On the other hand, it should be critically underlined that the initial development of mainstream CE has reached a stage of maturity and that there is an emerging demand to look towards CE models that are more inclusive, democratic, and transformative.

All the Just2CE Project research groups contributed to this e-book, allowing it to offer a broad and diverse representation of the different geographical, scientific and socio-economic contexts as well as the different practices and sectors related to CE. This has allowed us to create a contribution that reflects the multiple paths to achieve circularity, which contributes to fuelling a reflection on the future research paths and transformative innovation policies that may be pursued. All in all, this eBook and the Just2CE Project bring crucial insights for the CE scientific, business, and policy community and civil society seeking alternative forms of understanding and implementing a just transition to a CE.

Overview of the chapters

The Chapters contained in this e-book are divided into three main parts concerning respectively (i) the basic aspects and concepts of the CE, (ii) the measurement of just transition processes and initiatives, and (iii) the key factors of the just transition, such as environmental justice, gender and labour approaches. Although these are different aspects, they are interconnected based on the common objective of offering a space for discussion and reflection to achieve a just CE transition. The Chapters have been developed based on literature reviews and bibliometric analysis of the CE literature as well as empirical studies located in both Global North (GN) and Global South (GS)[1] countries. Moreover, the Chapters proposed different theoretical frameworks, scientific methods and political approaches to ensure a plurality of theorisations, interpretations, and understandings and to support public decision-makers in planning policy measures to favour the transition to a Just CE.

The numerous interrelationships between the topics covered in the chapters and their mutual influence demonstrate the complexity of implementing CE models which are socially just and environmentally sustainable. This complexity depends on a diversity of factors (regional norms, national and global socio-economic models, action and role of stakeholders, action of pressure groups, effectiveness of policies, etc.) which characterise CE in its current development phase. Part I of the e-book faces these aspects, illustrating the basic concepts and state-of-the-art regarding CE with particular reference to mainstream CE approaches, local economic models, different stakeholder engagements, social awareness, and shared responsibilities.

Development steps are affected by research progress and innovation, appropriate quantitative and qualitative measuring methods, and unwanted rebound effects and injustices in market economies. With this in mind, Part II of the e-book focuses on methods and indicators for measuring phenomena and topics (such as environmental impacts, environmental and social justice, and gender and labour inequalities). These indicators bring key insights and feedback to analyse the state of a just CE transition both in the GN and GS. Roadmaps to a just CE transition

[1] Global South and the Global North is a terminology that distinguishes not only between political systems or degrees of poverty, but between the victims and the benefactors of global capitalism. Available online: https://www.ipbes.net/node/41221 (see also footnote n.7, chapter 3).

are different in different areas. They may lead to stabilising a mainstream vision of CE without improving social and environmental characteristics, or they may engage stakeholders towards transformative change that enhances social and ecological well-being. These aspects are discussed in Part III with peculiar reference to changing patterns of mainstream technocentric CE in GN and GS scenarios, as well as transformative CE policies that consider critical issues of environmental justice, gender and labour. The essential messages of the book's 26 chapters are summarised below to offer readers an interpretative key to better approach and understand the variety and complexity of theoretical, policy and practical implementation aspects related to a just CE transition.

Part I provides an overview of the basic concepts and state-of-the-art of CE development.

Chapter 1 argues that a mainstream model of CE is still dominant while a model of CE more socially aware is emerging in the academic literature, whose seeds can be found in grassroots initiatives of the "social & solidarity economy", "care-centred economy", "civil economy", and "place-based sustainability" paradigms. Moreover, it is worth underlying the nascent literature focused on the link between the concept of "Just Transition" and that of "CE" since it shows case studies focused on the emergence of social *injustices* (e.g. fashion and e-waste trade from the GN to GS) for which a solution is urgently needed.

Barriers and drivers to a just CE transition based on the international literature and case studies evaluated within the JUST2CE project are summarised in **Chapter 2.** The purpose is to improve the knowledge about the factors (such as legislative, political, organisational, behavioural, economic, and social) that hinder or favour the implementation of a just CE and design adequate policies or delineate future research directions.

Chapter 3 highlights that one of the limits of mainstream CE approaches is the lack of socio-ethical considerations. The chapter addresses this gap by proposing a theoretical-practical framework grounded on the four pillars of the concept of "technologies of humility" (framing, vulnerability, distribution and learning). The chapter is particularly useful for researchers and policymakers seeking a framework to better assess and understand the social justice implications of CE developments and design transformative policies on that basis.

Social justice is an essential concept in the transition process towards a CE and is the core focus of **Chapter 4**. Social justice includes equality, equity, diversity, fairness, and human rights. A just CE transition implies societal changes that revise the balance between winners and losers so that susceptible countries and vulnerable populations are not left behind. As a result, a CE transition should promote inclusiveness and participation of all involved stakeholders and rely on appropriate methods and indicators that measure positive and negative impacts on social justice.

Shared responsibility emphasises the active participation of stakeholders to overcome the challenges of a CE transition. **Chapter 5** is a case study of one of the most discussed technological transitions of our time: the electric car. It shows that sharing costs between producers and consumers in the GN and GS could be one of the measures to ensure greater social and environmental justice. This is especially important for people in the GS, which bear the highest socio-ecological costs related to the extraction of materials needed for the electric vehicle transition.

Chapter 6 proposes a framework for evaluating scenarios of shared responsibility and just CE transitions. The framework takes into account different stakeholder groups and assessment tools, roadmaps and multiple indicators, including various comprehensive labour, gender and justice aspects.

Different regional patterns of CE development in the EU are outlined in **Chapter 7**, while **Chapter 8** looks at different patterns of CE implementation in the GN and GS. Both chapters highlight that the local context plays an essential role in shaping specific models of CE-making and that stakeholders in such contexts must be adequately listened to in defining the transition process. The adoption of a decolonial approach within the JUST2CE project (**Chapter 9**) contributed to widening the perspective of analysis of CE models in favour of a more open-ended and reflexive approach as well as a less partial and site-specific view of reality (e.g. beyond Western, Modernist, and EU-centric perspectives).

Part II centres on methods, indicators and integrated tools to measure a just CE transition.

Chapter 10 analyses 12 macroeconomic indicators developed and implemented by governments and international organisations. These indicators shed light on important aspects beyond Gross Domestic Product (GDP), which represents a valuable starting point for developing new indicators to measure the performances of a more transformative and socially aware CE. The design of these indicators should be open to potential stakeholders to test their validity in capturing socially desired aspects and performances.

The definition of sustainability and CE requires a new systemic understanding capable of capturing and modelling the dynamics between social and ecological systems. **Chapter 11** proposes novel hybrid approaches (including works rooted in humanities and art-based research) that adopt non-quantitative indicators to move beyond traditional managerial and policy approaches. It offers innovative ways to generate visions of desirable sustainable futures through a balanced integration of creative, reflective inquiry and normative pathways.

Chapter 12 demonstrates the value of a framework of Responsible Research and Innovation (RRI) as it fosters the reshaping of the CE discourse to enable a fair CE transition where people and the planet are at the centre. RRI could be beneficial to reframe mainstream CE research and innovation and create innovations that acknowledge and account for the socio-ethical impacts of CE practices.

The Sustainable Development Goals (SDGs) are studied in **Chapter 13**, evidencing the geographical distribution of the literature on SDGs and their links with CE. The link between the SDGs and CE seems to be much stronger for some of the SDGs, namely, SDGs 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land). On the other hand, it is weak or very weak for SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), SDG 10 (Reduced inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 16 (Peace, Justice and Strong Institutions).

Chapter 14 presents a critical analysis of the current assessment frameworks and indicators adopted to monitor the CE at national and international levels centred on accounting input and output flows. The chapter shows the importance of developing assessment frameworks that integrate further environmental aspects and could monitor the transition towards a CE in a holistic manner. Moreover, the chapter proposes ways to integrate life cycle assessment and emergy accounting frameworks.

An overview of the main assessment methods (life cycle assessment, life cycle costing, social life cycle assessment, material flow accounting, *emergy* accounting, internal rate of return, gender equality assessment) that can be used for the evaluation of environmental, social and economic impacts of CE applications is presented in **Chapter 15**. The latter highlights how these methods could be integrated to provide a more holistic and robust assessment framework and to overcome the limits of each individual method.

Chapter 16 shows the application of a combined framework involving Input-Output analysis and Stock-Flow Modelling for the simulation, evaluation and comparison of CE strategies. The first results suggest that adopting CE strategies in a market economy context is insufficient to achieve a just transition. This showcases the importance of requiring Governmental interventions to reorient the CE transition towards environmental and social justice goals.

Part III of the e-book focuses on an in-depth analysis of the three main facets of a Just CE Transition: Environmental justice, Gender and Labour, as well as the evaluation of CE across geographical areas.

Chapter 17 underscores the importance for CE to integrate the principles of the degrowth movement to include justice concerns in all their forms (distributive, procedural, and restorative) and to avoid the social and territorial impacts of the linear economy. The chapter showcases these arguments with a case study of waste pickers in Rio de Janeiro (Brazil). It finds that the mainstream CE model does not consider the value of informal repair, waste picking and unpaid reproductive work and that recognising the value of these jobs could be a step towards just transition policies.

Chapter 18 looks at links between gender, the SDGs and CE. It finds that, while the SDG's approach to gender, with its focus on women empowerment and leadership, is an important step towards reducing gender inequality, it does not challenge patriarchal norms and oppressive systems. Adopting a Feminist Ecological Economics approach, the chapter links the present socio-ecological crisis to patriarchal power relations and the lack of consideration for reproductive care work.

Chapter 19 shows how CE literature considers labour mainly in quantitative (e.g. number of jobs created with the circular activities) and, to a lesser extent, qualitative terms (e.g. decency or quality of circular jobs), while ignoring issues such as workers' decision-making, gender inequalities (e.g. unpaid circular labour that in most cases is done by women in the GS) and racism in the labour market. It argues that more investigation on these dimensions is required to avoid the transition to CE from perpetuating or even accentuating the social, gender and racial inequalities of the linear economy. Third-sector studies offer some of the most inclusive and transformative views about working conditions, gender and North-South relations, shedding light on case studies of very poor working conditions such as those of waste pickers in Bangkok.

The following three chapters offer insights into the social justice implications of the CE transition in different parts of the world. The transition to a just CE in Africa, as argued in **Chapter 20**, has the potential to reduce poverty, inequalities and environmental degradation. However, rapid urbanisation, industrialisation and population growth are essential challenges. Waste collection and recycling rates remain low, while the continent is becoming the illegal and disconcerting destination of consistent waste streams (mainly toxic) from the GN. In practice, the CE in Africa primarily concerns waste management and recycling activities, mostly performed as informal initiatives. These are a source of social injustices carried out by the poorest sectors of society without any social protection.

Chapter 21 analyses CE policies in Africa, showing how these are mainly developed at the country level or within the African Union (e.g. Agenda 2063) while being almost absent at the continental scale. The transition to a CE is primarily driven by private businesses and practitioners (NGOs, consultancies, entrepreneurs, and small and medium enterprises) who have developed relevant local CE innovations and technologies based on labour-intensive processes and cost-effectiveness.

Moving from Africa to Europe, **Chapter 22** analyses the EU's commitment to adopting CE. The latter has a central position in the Green Deal, the primary policy tool to pull the EU towards carbon neutrality. The EU has issued two specific Action Plans (in 2015 and 2020) for this aim. The second Action Plan strengthened the first by adding 35 new actions and setting the target of doubling the "circularity rate" by 2030. Almost all Member States in the EU have adopted a national CE strategy. However, in practice, the EU circularity rate is still low, with a strong asymmetry between member states and different regions of the EU. Just Transition mechanisms were also by the EU to compensate those territories (e.g. mining coal regions) affected negatively by the measures aimed at achieving climate neutrality.

Chapter 23 analyses the transition to CE in China and India. China is adopting a top-down approach, with the Chinese Central Government providing laws and regulations to impose the adoption of CE principles by companies and citizens. The Chinese 14th five-year plan for the 2021-25 period primarily focuses on improving environmental impacts, resource productivity and energy provision with related social implications. India seems less committed to facilitating CE developments and achieving a high level of sustainability and lacks a comprehensive policy framework supporting a CE transition. However, India has adopted policy initiatives to improve waste management, as well as policies supporting green manufacturing and encouraging more sustainable and circular consumption.

Chapter 24 imagines what different circular futures could look like by 2050. It does so by unpacking four competing circularity discourses, from mainstream technocentric visions to transformative degrowth-oriented circularity proposals. It examines what these four visions propose for future transport, energy, agriculture, industry, social, cultural and governance systems. The chapter shows that only post-capitalist and degrowth-oriented circular futures promote a socially inclusive and desirable path that ensures the well-being of all humanity within the biophysical boundaries of the Earth. All other growth-oriented circularities will eventually hit resource shortages and planetary limits and end up replicating and exacerbating current partners of injustice, inequality, exploitation and discrimination.

Chapter 25 presents a case study in Brazil, observed through the lens of Transformative Innovation Policies, highlighting the way CE-oriented initiatives could be conducted to contribute to a just transition. By starting from the bottom and focusing on the stakeholder engagement approach, Transformative Innovation Policies enable the inclusion of local community needs, leveraging cultural diversity and valuing their perspectives and experiences. The chapter thus highlights how innovation programs adapted to local communities' specificities represent a critical point to support a just transition that addresses social and environmental inequalities.

Chapter 26 analyses two participation experiments related to CE in the inner Cilento territory of the Campania Region of Italy. It compares the practices carried out to the political intentions included in the strategic documents dedicated to participation. The chapter's findings underline the importance of promoting a combination of top-down and bottom-up approaches in the development of local projects, facilitating the involvement of stakeholders in each territory to develop projects based on local specificities and needs.

PART I. BASICS OF THE CIRCULAR ECONONOMY AND STATE OF THE ART

The JUST2CE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003491

Chapter 1. Circular economy model, principles and just transition perspectives

Renato Passaro, Patrizia Ghisellini, Sergio Ulgiati

Abstract

This chapter introduces the CE concept and the socio-economic system that it proposes. The concept of CE was born more than fifty years ago by the early contribution of Kenneth Boulding, who conceived the economic system and the Earth as closed systems due to the acquired awareness that natural resources are limited. Therefore, resources should be used with care, eliminating the concept of waste to ensure the continuous reproduction of the resources needed in the economic system.

Over time, the CE concept has much evolved thanks to the contribution of Pearce and Turner in the nineties and further scholars of different research areas (such as System Thinking, Industrial Ecology, Ecological Economics, Environmental Economics). Currently, the Ellen Mac Arthur Foundation, since one of its first reports (2012), is one of the most involved organizations promoting CE dissemination and application. Besides the genesis of CE and its evolution, this chapter also offers an analysis of the current level of circularity worldwide, showing that more effort should be made to favour the transition from the linear and recycling economy to CE. Moreover, the concept of just transition is addressed in association with that of CE to provide an overview of its consideration in the international literature and academic research. The latter analysis shows several cases of social injustices worldwide in some sectors (e.g. fashion, e-waste, plastic waste and recycling). Solutions are provided by the selected literature to improve the current state and orient the transition to a more comprehensive and socially aware model of CE.

Keywords: Circular Economy, Circular Economy Principles, Linear Economy, Recycling Economy, Just transition.

> This chapter presents the basic concepts of existing CE models useful to give a preliminary and essential knowledge to the reader to appreciate the evolution of CE and its potential of tackling the current environmental and social challenges.

1.1 Introduction

The CE has become one of the most adopted buzzwords in current academic research, industries practice and policy discourse (Clube and Tennant, 2023; Ashton et al., 2022; De Lima, 2022; Nikolaou et al. 2021; Johansson and Henriksson, 2020) due to its potential of contributing to a better sustainable development (Evans, 2023; Lamba et al., 2022) and tackle the global environmental challenges such as climate change (Rödl et al., 2022) and the high

consumption of natural resources (Remme and Jackson, 2023; Circular economy gap, 2023). In the last decade, many studies have investigated the origin of the concept of CE, how the CE model works in practice, its limits/challenges and future directions (De Lima, 2022; Nikolau et al., 2021; Antikainen et al., 2018; Murray et al., 2017). Scholars underlined that the concept of CE is not new since it has origins in theories elaborated in the 60'-70' of the last century, such as Industrial ecology, Environmental economics and Ecological economics (Lamba et al., 2022; Antikainen et al., 2018), but undoubtedly can be considered new its premises of radically rethink the linear model of economy and society (Valencia et al., 2023; Antikainen et al., 2018) dominating since the second industrial revolution (Ellen Mac Arthur Foundation, 2023). In this regard, the CE model is much focused on redesigning production and consumption processes and a better valorisation and cycling of products, materials and components (Remme and Jackson, 2023; Antikainen et al., 2018; Murray et al., 2017). Some aspects are still less explored in CE discourse, such as the social impacts of CE implementation (Clube and Tennant, 2023; Lamba et al., 2022; Rask, 2022; Schöggl et al., 2020; Johansson and Henriksson, 2020; Murray et al., 2017). However, on one side, transitions towards CE (Bosman and Rotmans, 2016) and sustainability (Geels, 2011) are complex and long processes (Geels, 2011) since the path and the changes towards a new societal state and structure require time (Loorbach, 2007). On the other hand, it is important to identify barriers and challenges in the transition to avoid lock-in mechanisms preventing the transition from proceeding in the desired direction (Korhonen et al., 2018). In that, among the CE's current challenges, there is a lack of a clear policy vision (Upadhyay et al., 2022) as well as a restricted vision of CE centred on waste or recycling practice (D'Urzo and Campagnaro, 2023; Remme and Jackson, 2023; Van Langen et al., 2020) or specific social themes (e.g. employment) whenever the social impacts are considered in CE applications (Vanhuyse et al., 2021). The academic literature emphasizes that there is a so-called mainstream vision and development of CE (Calisto Friant et al., 2023; Villalba-Eguiluz et al., 2023; Genovese and Pansera, 2021; Clube and Tennant, 2020) as well as an "integral CE" model (Villalba-Eguiluz et al., 2023) more comprehensive and socially aware (Clube and Tennant, 2023) emerging from grassroots initiatives where the economic actors apply more radically the CE model and take care of the aspects of social inclusion, community development and just transition. This framework contains economic models that focus on the "Social & Solidarity Economy" (SSE) (D'Urzo e Campagnaro, 2023; Costanza, 2023; Villalba-Eguiluz et al., 2023; Mureau et al., 2017), "Care-centred economy" and "civil economy" paradigms (D'Urzo e Campagnaro, 2023; Nogueira et al., 2023; Bruni and Zamagni, 2015; Bruni, 2013).
Therefore, this chapter aims to provide an overview of the CE concept and models and their current development to enhance a more comprehensive understanding by all stakeholders, particularly policymakers.

1.2 Genesis and evolution of CE concept and model

The first contributions to the elaboration of the concept of CE and the associated model of economy and society date back to the sixties of the last century with the ecological economist Kennet Boulding (1966) who conceptualized the economy as a closed system similar to a spaceship with a limited amount of natural resources. Therefore, he suggested the economy as circular in order to assure a continuous regeneration of the materials. At that time, many scientists were increasingly afraid of the environmental limits of the natural environment in terms of the provision of the natural resources required to support the economy (Meadows et al., 1972) as well as its capacity to assimilate the different forms of pollution released to the environment (Bresso, 1993). In such years, the neoclassical and linear model of the economic system centred on the goal of quantitative economic growth was criticized by the nascent Environmental economics and Ecological Economics school of thoughts (Bresso, 1993).

Pearce and Turner (1989) further elaborated the idea of a circular economic system, suggested by Kennet Boulding, on the basis of the contribution by Georgescu-Roegen (1971) to the laws of thermodynamics that suggest matter and energy conservation (1st law of the thermodynamics) and degradation (2nd law of thermodynamics and entropy principle). In their model, Pearce and Turner (1989) propose a better management of natural resources and environmental goods on the basis of the recognition of an economic value to the environmental services provided to the economic system. Three relevant functions of the environment are pointed out: the environment is a provider of direct utility as well as of natural resources for the production of goods and services and is a receiver of waste from the production of goods and services (Panella, 2002). In the absence of this recognition, the economic system is considered linear in agreement with the neoclassical thinking that does not account for the relations of the economic system with the natural environment (Buonaiuti, 2014). Moreover, the attribution of an economic value is aimed to favour a better management of natural resources, environmental goods and services provided by the environment. These latter are finite, but in economic thinking, many scholars since Adam Smith (1776) considered environmental goods such as water or air as unlimited and freely available without paying a price (Smith, 1776) and because of this, “they play no part for economics” (Say, 1821).

Scholars of different fields contributed over the years to enrich the understanding of the closed-loop systems concept at the industrial level as well as to the further development of the concept of CE. In this framework, the “cradle to cradle” design philosophy by Michael Braungart and Bill McDonough (2010) provided inspiration to CE with the following three principles:

1. “Cradle to cradle” concept that emphasizes that the economic system should eliminate the concept of waste as the latter are nutrients and circulate in the biological or technical cycles;

2. “Renewable energy use” due to their lower environmental impacts than conventional energy sources;

3. “Diversity” to promote resilience in human systems.

A further relevant contribution has been provided by Walter Stahel, who dedicated much work to the development and application of the “closed loop” idea to production processes (Stahel, 1981), founding the Product Life Institute in Geneva more than 25 years ago focused in the promotion of the concepts of: “product-life extension, long-life goods, reconditioning activities, and waste prevention”. Stahel is also much concerned about the development of the “performance economy” and the importance of selling services rather than products. Finally, he also considers the CE to be an umbrella term grouping several specific ideas that are based on a set of principles. Janine Benyus created the Biomimicry approach (2002), defined as: “a new discipline that studies nature’s best ideas and then imitates these designs and processes to solve human problems”. She believes that Nature can provide human society with the solutions to the great challenges of our time since Nature has solved many issues that humans are experiencing. For example, birds are able to fly without using fossil fuels.

Industrial Ecology is focused on the investigation of the flows of material and energy throughout the industrial systems. It deserves attention on the creation of connections between operators within the industrial ecosystem and closed-loop processes where waste generated by an operator or process becomes input for others, in so eliminating undesirable by-products (Graedel and Allenby, 1995; Frosch, 1992). "Industrial ecology adopts a systemic point of view, designing production processes so they perform as close to living systems as possible. This is achieved by considering local ecological constraints and looking at the global impact of processes from the outset". Finally, Industrial ecology also aims to perceive higher social well-being due to its focus on natural capital restoration, which is key for promoting sustainability.

Important contributions also came from the "regenerative design" approach by John T. Lyle (2010) which is applicable to all systems that become on that basis more resilient because they are designed as closed-loop systems (Ikerd, 2021) as well as from the blue economy movement and philosophy of the Zero emissions research and initiatives promoted by Gunter Pauli. The Blue Economy is a movement that encompasses a wide range of actors (such as companies, consumers, and scientists) and proposes an economy that generates the least impact to the environment and relies for the satisfaction of its needs on local systems of production and consumption.

Finally, all these schools of thought converged to the current CE concept promoted since the year 2010 by the Ellen MacArthur Foundation. The latter has been at the forefront in the dissemination of the CE concept and applications by means of a series of reports setting the fundamental aspects of a CE and its functioning. The Foundation was created by the British sailor Ellen MacArthur, who acquired the awareness that natural resources on Planet Earth are finite, perceiving the need for the transition to an economic model (namely, CE) for better use of natural resources compared to the linear economy model. The CE model by the Ellen Mac Arthur Foundation is currently considered the mainstream vision of the CE (D'Urzo and Campagnaro, 2023). However, after an initial general consensus, several scholars started to criticize this vision underlying several limits, including its capacity to put under discussion the capitalist paradigm dominant in the governance of the global economy and suggest its reform (Genovese and Pansera, 2021; Giampietro and Funtowicz, 2020; Reike et al., 2018). Moreover, this CE model considers mainly the environmental and economic dimensions of sustainability and, to a limited extent, the social one and its balance (D'Urzo and Campagnaro, 2023).

The bulk of CE research is still concentrated on studies dealing with management and corporate business models as well as waste management and recycling, while the other principles (e.g., reuse, repair and reduce) are less investigated (Schöggl et al., 2020). Similarly, until now, the analysis of the different dimensions of sustainability in the academic literature privileged the environmental and economic ones, while the social received less attention (Johansson and Herikksson, 2020; Schöggl et al., 2020).

It is important to mention that more comprehensive and socially aware CE models are emerging from case studies applying the CE at the local scale in particular in cities (Bozeman et al., 2023; Ghisellini et al., 2022; Rask, 2022; Petoskey et al., 2021; Ghisellini and Ulgiati, 2020; Prendeville et al., 2018) and are showing the ecological transformation as well as a reorganization of the economy and social life more in line with the well-living of people and environment (Clube and Tennant, 2023). These cases are based on the integration of ethical values disruptive of the economic logic of efficiency and profit maximization, which depict the neoliberalism thought and model (SPES Annual Conference, 2022) and widen CE mainstream vision as well as the meaning itself of an economy and its position within the environmental and social systems (Moreau et al., 2017; James, 2022). These latter authors intend the economy as a subsystem of society (Parsons and Smelser, 1956). The economy is not neutral to social relations and the impacts of their activities, such as related to: "justice, inequality, poverty and exploitation" (Ashton et al., 2022; James, 2022) since it has a social purpose and recognizes the potent role of social norms and institutions (Polany, 1944) in explaining economic development and the well-being and happiness of people. Institutions (e.g. Governments and the laws) were considered promoters of equity and oriented to public happiness since the early contributions of some of the founders of the ancient school of civil economy of Naples, such as Antonio Genovesi (1768) and Gaetano Filangeri (1783). In that, the economic activity, for those scholars, was strictly influenced by social norms such as trust, reciprocity and equity. On the other hand, in such years, the physiocratic school of thought (Quesnay, 1758) conceived both the economy and society as open systems to the environment (**Figure 1.1**), thereby taking into account its biophysical limits.

After these two schools of thought, the biophysical/environmental and societal dimensions were progressively excluded from the economic analysis while returned to be integrated to some extent in the last century thanks to the contributions of Ecological Economics (Boulding, 1966; Georgescu-Roegen, 1971), Environmental Economics (Pearce and Turner, 1989) and Institutional Economics (Polany, 1944; North, 1994) respectively.

Moreau et al. (2017) explore the SSE as a model embedding the theoretical framework of Institutional Economics to show "how institutional conditions can contribute to the development of a CE by taking into account social institutions, societal norms, and political considerations". They investigate labour conditions in the city of Geneva and show the advantages of an SSE in reducing e.g. the inequalities in terms of salaries among employees. In the SSE, people are placed above profits rendering clear the value system "towards more equitable labour conditions and participative decision making, but also toward social wellbeing and the democratization of the economy overall" (Moreau et al., 2017). Untangling the economy from the main logic of efficiency and profitability could lead to decisions also with regard which CE strategies (which materials should be reused or reduced or which should be recycled) are more positive for the environment because the main goal is identifying the CE model that fits better the limits of the natural environment (Moreau et al., 2017).

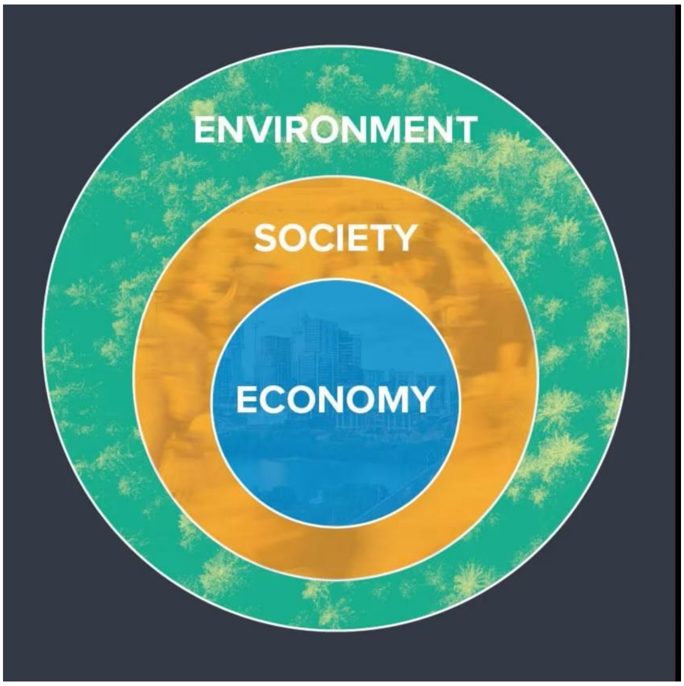

Figure 1.1 The relations between the natural environment, the economy and society in the socially aware CE. Source: https://www.ellenmacarthurfoundation.org/systems-and-the-circular-economy-deep-dive

1.3 Linear economy, recycling economy and circular economy

The advent of the CE model can be conceived in light of the huge environmental effects of the linear production and consumption model that still dominate worldwide (Moreau et al., 2017). The current global economy is only 7.2% circular (Circular Gap Report, 2023), meaning that only 7.2% of all input consists of secondary materials, while more than 90% of the materials are wasted, lost or are not available for reuse since they are stocked temporarily in products such as buildings and machinery (Circular Gap Report, 2023).

One of the characterizing aspects of the current worldwide linear economy is the massive consumption of natural resources. United Nations data[2] underline that the consumption of natural resources continues to rise while the efficiency in their use does not improve at the same pace, mainly regarding energy consumption. The amount of waste generated is also increasing (Kalmykova et al., 2016). Therefore, the so-called "decoupling" is far from being reached, and urgent actions and policies are required in order to ensure an equitable distribution of resources within and across generations and avoid the continuous overextraction of resources and environmental degradation (Warlenius, 2023). It is significant to highlight in this regard that, despite the great attention on reducing pollution due to the dispersion of plastic in the environment, in the G20 countries it is estimated that plastic consumption will more than double by 2050. (Back to Blue, 2023)

The indicator of material footprint gives an idea of the consumption of natural resources that supports the production of wealth in the global economies and the material needs of the population. The evolution of the material footprint worldwide shows that the indicator has grown from 28.6 billion tonnes (Gt) in 1972 to 101.4 billion tonnes (Gt) in 2021 (**Figure 1.2**). It is expected that by 2050, the global material footprint will rise to 170-184 billion tonnes (Gt) in the absence of effective political actions able to reverse the trend and achieve a reduction of the material footprint3 in particular in high-income countries (Circular economy gap, 2023; UN, 2017).

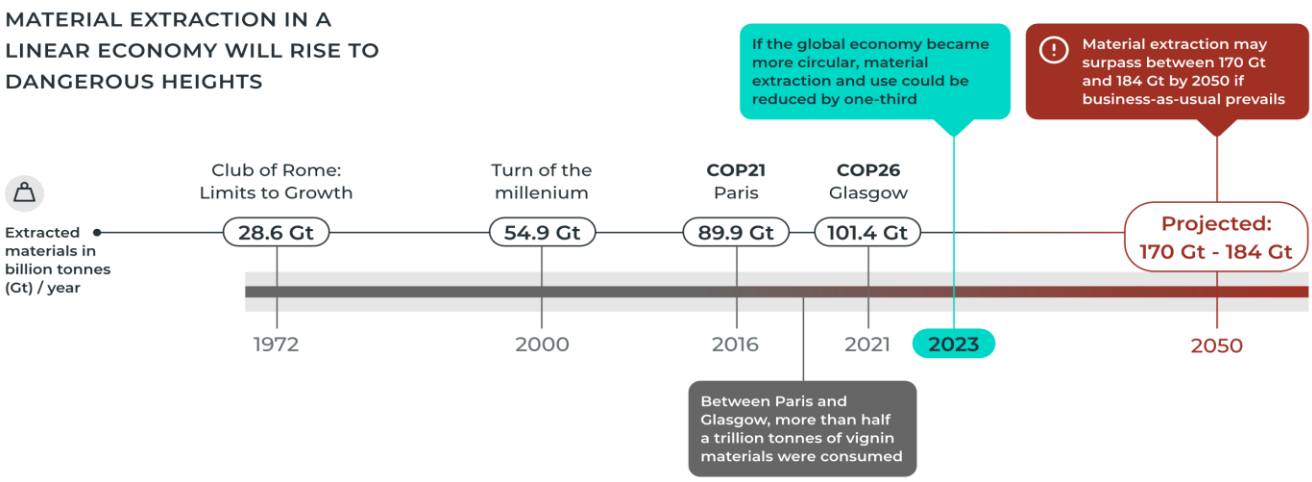

Figure 1.2 Global material footprint in the global economy from 1972 to 2050. Source: Circular economy gap, 2023.

[2] https://unstats.un.org/sdgs/report/2019/goal-12/
[3] https://unstats.un.org/sdgs/report/2019/goal-12/

The United Nations statistics (2017) also provide data about the material footprint per capita, which show that in the year 2017, high-income countries had the highest material footprint (26.3 metric tonnes per person) compared to the world average (12.2 metric tonnes), while the other countries recorded the following levels of consumption: upper-middle-income (16.9), lower-middle-income (4.7), low-income (2.0). The UN also remarks on the dependence of Global North countries on materials extracted elsewhere, particularly in the Global South, since the material footprint indicator is higher by 9.8 (metric tonne per capita) than domestic material consumption per capita (17.9 metric tonnes). Therefore, improvements in resource use and more sufficiency lifestyles are needed (Villalba-Eguiluz et al., 2023) that strongly reduce the consumption of natural resources (Bocken and Short, 2021). Policies are fundamental to stimulate this shift in consumption (Remme and Jackson, 2023; Rask, 2022) since it is claimed that the application of CE alone will not be able to reduce the material footprint (Bocken and Short, 2021).

Figure 1.3 summarizes these aspects, highlighting the main differences between linear, recycling economy and CE, evidencing that the latter, by design, should incorporate more sustainable production and consumption models in order to ensure that the economy feeds itself while minimizing the use of natural resources by "keeping material in use without degrading their quality or downcycling into lower valued products" (Ellen Mac Arthur Foundation, 2023). It is also worth pointing out that in the recycling economy, products are designed to keep the value of materials and products in a shorter time than the CE. As a result, in a recycling economy, resources should still be extracted, and the production of waste is inevitable. Moreover, while recycling is a practice that is more environmentally sound than landfilling or incineration, on the other hand, it requires energy (Mah, 2022). Only a few elements in the periodic table have recycling rates above 75%, while most of them can be recycled once, and others cannot be recycled at all (Graedel, 2021). Finally, recycling as an economic activity is often performed far from the point of generation of the waste to be recycled and is mainly oriented to the pursuit of economic efficiency (Stahel, 2016), disregarding the environmental and social impacts (Ghisellini et al., 2023).

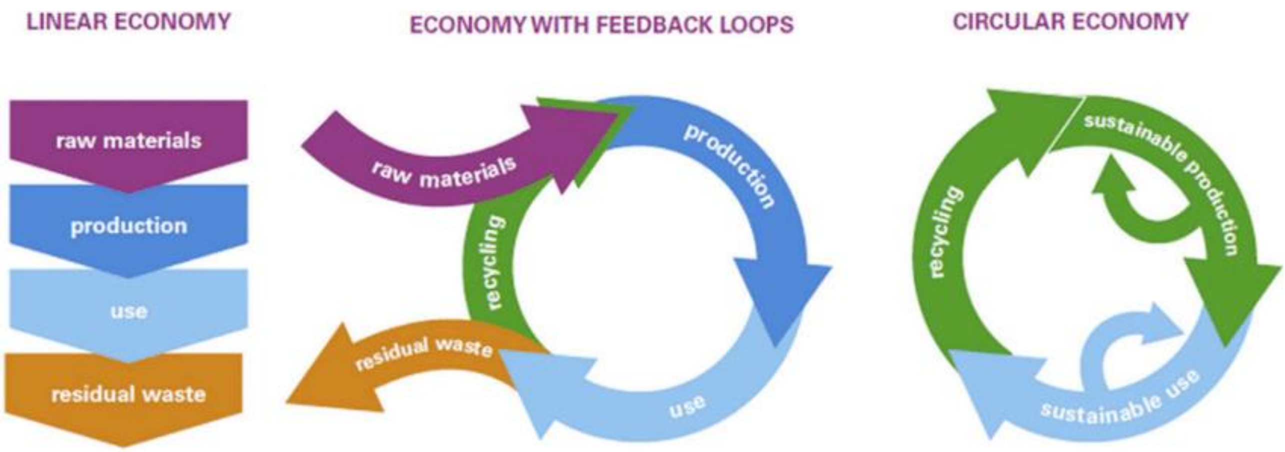

Figure 1.3. The life cycle of products in the linear, recycling and circular economy. Source: Van Bueren et al., 2016.

1.4 The circular economy model and its principles: the mainstream vision of CE

After the surge of the concept of CE in the last decade, many scholars have provided a definition of CE (Kirchherr et al., 2017). The most recent by the Ellen Mac Arthur Foundation (2023) indicates that CE is: *a system where materials never become waste and nature is regenerated. In a circular economy, products and materials are kept in circulation through processes like maintenance, reuse, refurbishment, remanufacture, recycling, and composting. The circular economy tackles climate change and other global challenges, like biodiversity loss, waste, and pollution, by decoupling economic activity from the consumption of finite resources* [4].

This definition is entirely focused on the environmental dimension of the CE that, until now, is the sustainability dimension mainly emphasised by the literature (Dzhengiz et al., 2023 [5] ; Mies and Gold, 2021). Three important aspects (and principles) emerge in this definition: the elimination of the concept of waste, the circularity of products, materials, and components, and the positive contribution of the economy and society to the environment in the regeneration of natural resources. At the basis of these aspects/principles, there is the concept of design by which products and materials are thought to last longer than conventional products of the linear economy by a series of strategies aimed to circulate products and materials to retain most of their values (maintenance, reuse, refurbishment, remanufacturing, recycling and composting).

Finally, circulation means that products at the end of their life can still be useful as materials or components, avoiding the production of additional waste and further prolonging their intrinsic value. This model of CE is depicted in **Figure 1.4** in the so-called Butterfly diagram, where each of the two wings represents the biological and technical cycles of the model of CE. In the technical cycle (marked in blue), products circulate by means of the application of different strategies such as reuse, repair, remanufacturing, and recycling, while in the biological cycle, organic products and materials can safely return to the soil through processes like composting and anaerobic digestion and be valuable nutrients for the regeneration of the soils.

The Ellen Mac Arthur Foundation (2023) proposes to handle products and materials in the technical cycle at cascade[6]. Given that the goal is "*keeping products whole to retain the maximum possible value*", the best option is based, e.g. on sharing by which the products could be used over time by users who do not own the product. Further options could be the reuse of the product by means of the resale and later cycles of maintenance, repair, and refurbishment. "*When the product can no longer be used, its components can be remanufactured. Parts that cannot be remanufactured can be broken down into their constituent materials and recycled. While recycling is the option of last resort because it means the embedded value in products and components are lost, it is vitally important as the final step that allows materials to stay in the economy and not end up as waste*" (Ellen Mac Arthur Foundation, 2023).

[4] https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
[5] https://ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview
[6] Cascade is about a succession of processes by which an intermediate product is used as a feedstock for a succession of processes. In this way, the value of raw materials is optimized because it is possible to obtain multiple products rather than only one product. Available online: https://www.borregaard.com/sustainability/planet/circular-economy-and-cascading-use-of-biomass/ (last accessed: 23/10/2023).

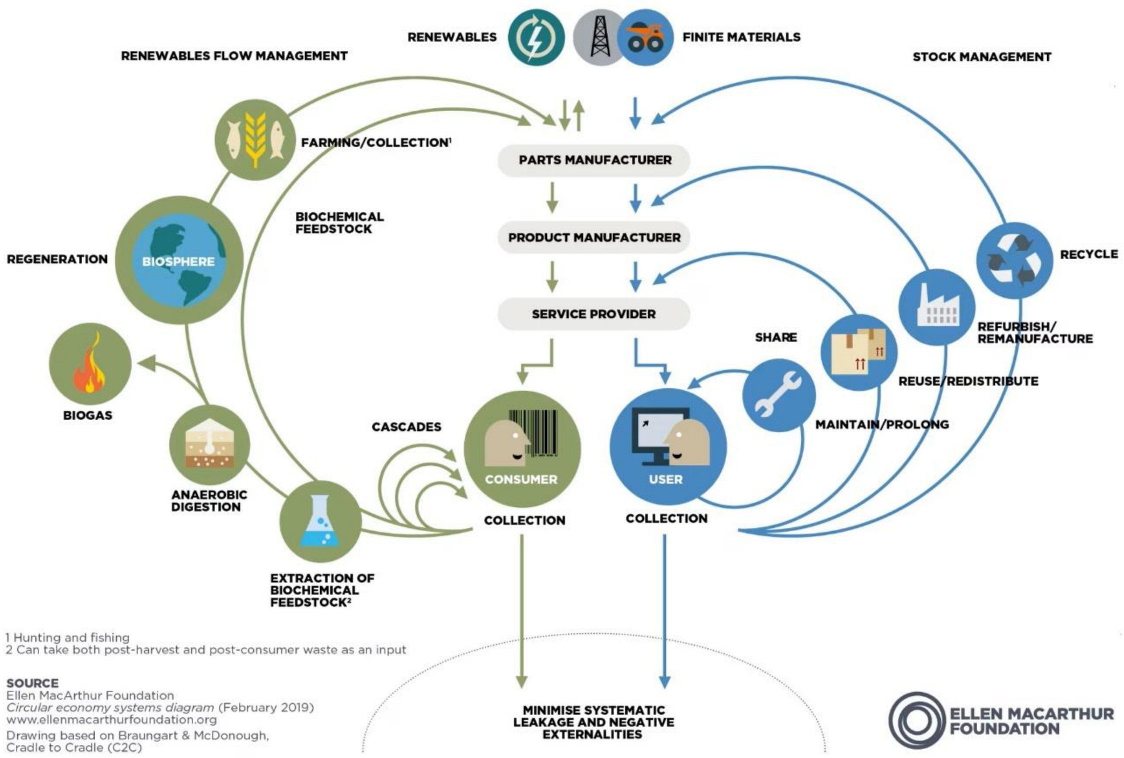

Figure 1.4 CE strategies in the technical and biological cycles. Source: Ellen Mac Arthur Foundation, 2023.

1.5 The circular economy and the "just transition" discourse

It would be a deep mistake to ignore how the existing literature is linking and elaborating the concept of "just transition" to that of CE and its model. For this purpose, we performed a search on Web of Science using the keywords "circular economy" and "just transition" and selected the literature including these two concepts. In that, the literature review of this study can be considered integrative of the one performed in other chapters contained in this e-book that reviewed the literature using as keywords "circular economy" and "environmental justice" (chapter 17), "circular economy" and "gender" (chapter 18), "circular economy" and "labour" (chapter 19).

On the basis of our analysis, the relation between CE and just transition started to be mainly investigated by the academic literature from the year 2020 onwards. Within this stream of the literature, some of the proposed theoretical frameworks comprise that of Responsible Research and Innovation (RRI) (Purvis et al., 2023; Pansera et al., 2021) and frameworks that are focused on the dynamics of incumbency in energy transition and the power that incumbents play in "blocking" the adoption of alternatives more socially and economically sounds and scientifically realistic (Remme and Jackson, 2023; Stirling, 2019). In this view, RRI is particularly useful to put under discussion the current mainstream model of CE and analyse its implementation in the light of social justice concerns, suggesting a way to take the latter into account in CE practices (Purvis et al., 2023)

The selected literature also underpins cases of great challenges to overcome (e.g., the trade of textile waste or e-waste from the GN to the GS), providing possible responses to improve state of the art and profoundly embedded injustices.

Therefore, in this study, the theme of "just transition" within CE is regarded not only as the "energy transition" to renewable energies (Mutezo and Mulopo, 2021) and challenges of the revitalization of coal post-mining sites (Cala et al., 2021), but also as energy poverty issues (Streimikiene et al., 2021) and environmental and social impacts of metals extraction (e.g., cobalt) for the transition to electric vehicles (Rachidi et al., 2021; Remme and Jackson, 2023). In this regard, Remme and Jackson (2023) evaluate the CE policies in Norway, including the ambitions for the electric vehicle transition, highlighting the injustices that such transition could imply throughout the life cycle and the environmental costs for the countries where the metals are extracted. Therefore, the authors warn that CE and electric vehicles development, rather than favouring a just transition, could perpetuate colonial injustices and become a profitable industry that accumulates wealth for a small number of elites in the GN at the expense of the GS (Chapter 6 of this e-book written by Liu and Ulgiati will deal with global electric vehicle transition in more details analysing the environmental and social costs of the transition).

Other researches have focused on waste trade from the GN to the GS. For instance, Thapa et al., 2022 have analysed the movements of waste electrical and electronic equipment trade towards African countries (Nigeria), while Nagarajan et al. (2022) investigated plastic recycling as a production activity in India and the rights of workers and small-scale enterprises. Valencia et al. (2023) explored waste picking in two countries of Latin America, finding that the creation of social provisioning communities with female waste picking contributed to giving dignity to labour recycling as well as care and political representation. Lima et al. (2022) evaluated the bioeconomy transition in Brazil, India and Indonesia and the different types of injustices that are created, while Suarez-Visbal et al., (2022) addressed the social impacts on workers regarding the quality of jobs and livelihood, gender equality and social inclusion in the apparel value chain. Leclerc and Badami (2023) analysed the formal and informal e-waste flows, the actors involved in these latter, and the associated environmental and social impacts in Montreal, finding that these flows are not as distinct as those found in previous research. Persson and Hinton (2023) investigated the changes in the second-hand clothing market in Sweden following the presence of different forms of non-profit and for-profit businesses to evaluate how they influenced the transition to a socially just CE. These Authors underscore the importance of strengthening the extended producer responsibility to enhance the reuse and repair activities and its integration with other tools to discourage the exports of clothing waste as well as their destruction. From this perspective, it is important to highlight that the problem of fast fashion is a very serious global issue, and GS countries where most garments are exported from the GN are organizing activities such as repair and upcycling to increase the durability of exported garments to avoid their landfilling (Vanacker et al., 2023). These authors have analysed these issues to assess the relationship between circularity, garment durability and just transition. On the basis of the results, the authors stress that people should be placed at the centre of this relation to ensure a just circular economy in this sector. Further, Papamicheal et al., (2023) argue that it is key to combine different business models of circular fashion (based on the concept of slow fashion) to facilitate the adoption of a holistic approach for achieving a just transition to the CE in the fashion industry. Moreover, the use of textile fibres produced from crop residues would be an important result towards a more circular fashion sector. Small farmers in India are crucial actors in providing the needed biomass, but their institutional power is still limited. As a result, their power should be strengthened in order to assure a just and circular transition in the sector (Harry et al., 2020).

Moving beyond fashion, Otlhogile and Shirley (2023) have analysed the history and evolution of the just transition movement, showing that it has become a framework for specific groups and communities since it gathers movements belonging to just urban, rural, circular economy and energy transitions. They analysed case studies about these movements in local and regional contexts to improve the understanding of their activities and their progress in Africa and create consensus around them for local and national stakeholders.

The participation of all the relevant stakeholders and the relations between them are important in a just transition to CE (Vanhuyse et al., 2023) since e.g. small-scale institutions struggle in the transition due to the poor organization of their waste services for the local communities requiring support from the national institutions (Ghisellini et al., 2023b). Therefore, methods such as life cycle assessment, social life cycle assessment and social impact assessment (Vanhuyse et al. 2022) are relevant in a just transition perspective to analyse the environmental impacts and the social relations and impacts of CE implementation (Ghisellini et al., 2023c). These methods and related indicators can be expanded to better fit the CE purposes (Luthin et al., 2023) and integrated into other methodological approaches to provide a wider understanding at hand for policymakers and their need for monitoring and evaluation of the progress and impacts of a just transition (Purvis and Genovese, 2023). However, measuring social impacts still faces many challenges due to the qualitative aspects to be measured as well as the conventional data sources that are not appropriate for measuring circularity (Pitkänen et al., 2023).

1.6 Conclusions

This work aimed to give preliminary and essential knowledge about the evolution of the CE concept, model, and principles and link it with the just transition concept to evaluate its potential to contribute to the current socio-ecological challenges. The CE originated in the last century from different schools of thought and mainly in response to the increasing environmental challenges of the linear economic model. The mainstream vision of the CE model continues to represent an important reference model for CE development since it is based on the elimination of the concept of waste by design, on the key role of renewable energies, the circulation of materials, products and components based on the optimization of their value, on the regenerative capacity of circular practices producing biological nutrients for the soils and the improvement of biodiversity. However, several scholars also underline the importance of adopting a CE model that considers the social impacts of CE implementation to provide a more meaningful and transformative response to the social challenges ahead of the linear economy and recycling economy. The analysis of literature dealing with the themes of Just Transition and CE shows that many case studies contribute by signalling injustices and suggesting solutions to overcome them, as well as best practices and innovative frameworks. Therefore, it is important to disseminate this knowledge and raise awareness among all the stakeholders, and policymakers in particular, that a more comprehensive and socially aware model of CE should complement the mainstream one to help overcome its current challenges and design a social justice-oriented, model to overcome the present focus on economic activities and environmental protection.

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Chapter 2. Current just transition to the circular economy: main drivers and barriers

Ivana Quinto, Renato Passaro, Patrizia Ghisellini, Sergio Ulgiati

Abstract

This chapter presents an overview of the main barriers and drivers to a just CE transition. Data collection has been performed by means of a search in the Scopus database. The search with the keywords "barriers and drivers", "Circular Economy", and "just transition" has identified 34 articles. It is interesting to point out that the timeframe of the published articles is short as the identified literature concentrated in the last five years. The main results show that different kinds of barriers and drivers exist for each actor of socio-economic ecosystems. Despite this, policymakers can play a critical role in defining appropriate policies to better exploit the existing opportunity (drivers) and address the main challenges (barriers). Therefore, the analysis of the main barriers and drivers to a just CE appears to be very important for providing helpful feedback to the policymakers that can be used to inform the definition of proper and effective measures, policies, and incentives.

Keywords: Circular Economy, Barriers, Drivers, Just Transition, Fairness, social impacts

> This chapter aims to develop an outline of the main barriers and drivers to the transition towards a just CE with the purpose of providing useful knowledge about the factors that influence negatively and positively the implementation.

2.1 Introduction

The concept of CE has emerged as a pivotal societal shift in our approach to production and consumption, aiming to minimize environmental impacts, foster economic resilience and innovation and promote sustainable practices throughout the entire product life cycle (Galindo-Martin et al., 2021; Knäble et al., 2022). As the discourse on CE has evolved, there is a growing recognition that the transition towards a CE must not only address environmental concerns but also embrace a holistic perspective that includes social justice considerations (Purvis et al., 2023). This recognition has given rise to the concept of a "just transition," emphasizing the need to ensure that the transition to a circular economy has to be equitable, inclusive, and socially just (Ghisellini et al., 2021; Kirchherr et al., 2017; Mies and Gold, 2021; Pansera and Genovese, 2021;).

Specifically, the shift to circular practices has the potential to disrupt traditional industries, impact employment structures, and create new economic opportunities. This necessitates a careful examination of the social consequences to avoid exacerbating existing inequalities.

The concept of a "just transition" recognizes that certain individuals, communities, or industries may disproportionately bear the burdens of this transformation. Workers in industries undergoing substantial changes, for instance, might face job displacement, and communities dependent on certain economic activities may experience adverse effects. Addressing these challenges requires proactive policies and measures to ensure that the transition is fair, inclusive, and considers the well-being of all stakeholders. By aligning environmental, economic, and social objectives, we can create a sustainable and resilient future where the benefits of circular practices are shared equitably across society.

Until now, the literature on the CE has mainly focused on enhancing comprehension of the CE concept and model, its origins, its definition (Henry et al., 2020; Uvarova et al., 2023), the incorporation of this new model into corporate practices (Ghisellini et al., 2023; Centobelli et al., 2020; Lüdeke-Freund et al., 2018), and, only lately, its broader societal implications (Calisto-Friant et al., 2020). However, social issues arising from the CE transition cannot be delayed, necessitating urgent action from policymakers, global society (Luthin et al., 2023), as well as scholars and academics (Valencia et al., 2023; Ghisellini et al., 2021). Put differently, there is a call to enhance the theoretical and practical framework of CE, broadening its discussion to include the social impacts of its transition (Luthin et al., 2023). More in general, it is important to underline that a just transition in the circular economy involves intentional efforts to integrate social equity into policy frameworks, business strategies, and community engagement. This includes providing support and opportunities for retraining and upskilling workers affected by industry shifts, creating inclusive business models, and considering the broader societal impacts of circular initiatives.

Based on the above, this chapter aims to shed light on the drivers and barriers to a just transition to CE through a systematic literature review. Hence, the findings of this chapter could be used by academics, policymakers and practitioners to facilitate a fair transition to circularity by proposing potential solutions for each obstacle.

2.2 Material and Methods

To evaluate the current state of research in the areas under investigation, this paper employs a Systematic Literature Review (SLR) methodology. In particular, a rigorous SLR is instrumental in generating robust knowledge about the existing body of literature in a specific research domain, contributing to the identification of research trends, paths and potential future research (Massaro et al., 2016; Petticrew and Roberts, 2006). As recommended by Tranfield et al. (2003), we adopted a manual filtering, which offers a reproducible process that helps reduce bias in the findings. In contrast to automated filtering, this method enables authors to transparently review and synthesize all relevant contributions, focusing on both quantitative and qualitative aspects.

We defined a research protocol to select information sources and tools for studying and analysing the contributions, as well as to discuss and investigate the results (Petticrew and Roberts, 2006). In line with other studies (Feng et al., 2017; Massaro et al., 2016), we conducted both bibliometric and content analyses to ensure the accuracy of the findings from the selected studies.

Following established SLR guidelines (e.g. Easterby-Smith et al., 2015), our methodology comprises five different steps (**Figure 2.1**). More in detail, the initial step for a rigorous SLR is the formulation of research questions (Massaro et al., 2016), while the second one entails the creation and application of an SLR protocol. This protocol facilitates the identification of information sources to be utilized, the establishment of inclusion/exclusion criteria for paper selection, and the determination of the methods and tools to be employed during the exploration and synthesis of the selected articles (Petticrew and Roberts, 2006).

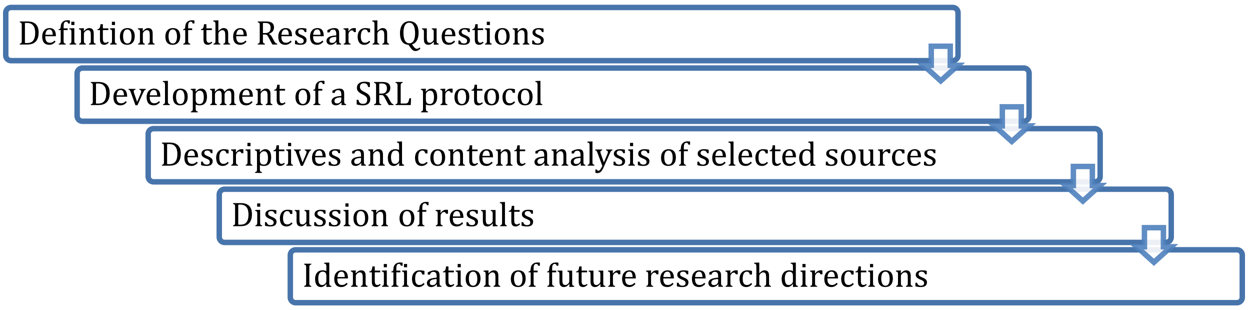

Figure 2.1: Main steps of our methodology

Regarding the third phase, we performed an SLR and a bibliometric analysis to improve the accuracy of the results obtained from the literature review (Secundo et al., 2020).
Based on the analyses carried out, we critically discussed the results obtained and identified a research agenda able to guide and inspire future research.
In the following section, the main steps of the SLR will be thoroughly explained.

2.2.1 Main steps for the paper selection

With regard to the paper selection, it is worth underlining that we decided to select papers from the Scopus database as it is the largest one and provides comprehensive scientific, technical, and social science materials across all relevant scientific literature (e.g. Thelwall, 2018; Waltman, 2016). Afterwards, we employed a search string that offers wide coverage to minimize the risk of excluding pertinent studies. The paper selection was realized until September 2023. This approach allows for a comprehensive understanding of the evolution of the relationship between CE, just transition and their related drivers and barriers to its implementation. In particular, we linked key search terms like "Circular Economy", “CE", "just transition", "fair transition", "barrier*", and "driver*" using boolean operators AND/OR. The asterisk in the search string represents truncation, enabling us to retrieve all relevant studies, regardless of term variants (e.g., "barrier" and "barriers").
Based on this strategy (**Figure 2.2**), we selected an initial sample of 34 English-language contributions published until September 2023. Furthermore, to narrow the focus on contributions closely aligned with the investigation's subject matter, two researchers independently analysed the 34 papers extracted from Scopus. A third researcher was consulted in cases of uncertainty (Cannavacciuolo et al, 2023). This analysis was based on the entire content

of the papers rather than just the abstract or specific sections. If a paper did not simultaneously address the concepts analysed, it was excluded from the sample. Following this process, 24 papers were ultimately selected, and three researchers collaborated to categorize the papers within the final sample.

Subsequently, we conducted a descriptive and content analysis by calculating various variables (e.g., distribution of articles per year, citation indexes, top journals) and conducting an in-depth examination of the selected papers. This analysis allowed for the critical discussion of the results, leading to the formulation of a research agenda.
The descriptive analysis involved a comprehensive overview of the selected articles. Specifically, we considered the following viewpoints for this analysis:

- temporal evolution;
- top publication journals;
- the most influential authors;

2.3 Results

The final sample of papers includes 24 contributions for which a bibliometric analysis was performed to provide a general overview of the investigated topic. In particular, in this section, the results of the SLR are thoroughly discussed and organized into the following sections:

1. Bibliometrics
    - Papers per year
    - Papers per source
    - Citations per year and top-cited papers
2. Content analysis of the sources

2.3.1 An overview of the selected papers: a bibliometric analysis

As depicted in Figure 1, the first paper in our sample concerning the analysis of barriers and drivers to CE and just transition implementation was published in 2018. In accordance with this, it is possible to claim that the time span is relatively short, proving that it is a quite recent topic dealt with in literature. Additionally, it is worth underlining that there is still a positive trend in the number of papers published, although there is not yet a strong increase in studies on these themes, showing that they are still underexplored. Despite this, this positive trend of publications indicates a growing interest among scholars in the analysis of drivers and barriers to a just CE transition, underscoring the novelty and relevance of this research area.

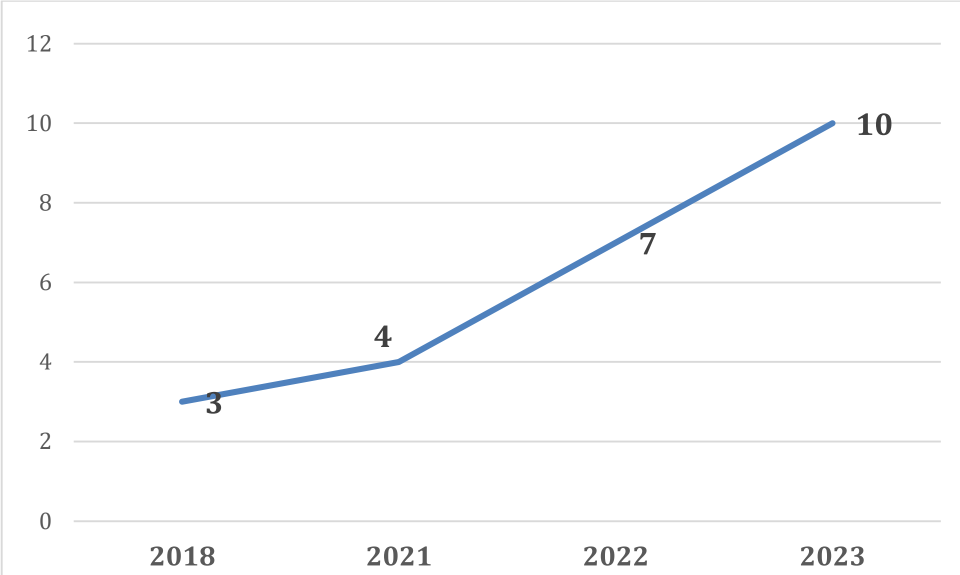

Figure 2.2 Papers trend publication over time

As presented in **Table 2.1**, the publications in our sample span across various disciplines and are published in a diverse range of journals. Specifically, the fragmentation within the scientific community concerning drivers and barriers to a just transition becomes apparent when examining the journals in which articles from our sample are published. Notably, only 3 out of 14 journals have published more than one article related to this topic. These include the Journal of Cleaner Production, with four articles, followed by Sustainability and Ecological Economics, with three articles and two papers, respectively. It is evident that these journals offer diverse perspectives on these topics, with a particular focus on the environment, business and sustainability. This indicates that the concept of the just transition is explored from various angles.

Table 2.1 Journals per N° of published articles and citations

Journals	Number of papers per journal	Citations
Journal of Cleaner Production	4	371
Sustainability (Switzerland)	3	29
Ecological Economics	2	150
Business Strategy and Development	1	5
Circular Economy and Sustainability	1	8
Field Actions Science Report	1	1
Forest Policy and Economics	1	22
Journal of Responsible Innovation	1	12
Local Environment	1	4
Production Planning and Control	1	29
Renewable and Sustainable Energy Reviews	1	114
Resources, Conservation and Recycling Advances	1	19
Socijalna Ekologija	1	0
Sustainable Chemistry and Pharmacy	1	4

The remaining 11 journals have each published just one article, although in some cases, these articles have received a high number of citations. For instance, *Renewable and Sustainable Energy Reviews* published, in 2021, one article that garnered 114 citations, and *Production Planning and Control* published an article in 2018 that received 29 citations.

Table 2.2 provides a list of the top ten most cited papers and their respective citations per year (CPY). CPY is calculated by dividing the total number of citations by the number of years since the author or journal started publishing papers. In general, it is worth emphasizing that the most influential authors are Neves and Marques (2022), who published their contribution in the *Journal of Cleaner Production*, followed by a paper authored by Kirchher et al. (2018) in the *Ecological Economics* journal. Moreover, to enhance the evaluation of authors' citation trends, it is crucial to take into account the Citations Per Year (CPY). This is because studies published more recently, as highlighted by Dumay (2014), naturally have had less time to accumulate citations. Consequently, this temporal factor can introduce bias into potential findings.

Authors	Year of publication	Title	Journal	Citations	CPY
Neves S.A.; Marques A.C.	2022	Drivers and barriers in the transition from a linear economy to a circular economy	Journal of Cleaner Production	341	170,5
Kirchherr J.; Piscicelli L.; Bour R.; Kostense-Smit E.; Muller J.; Huibrechtse-Truijens A.; Hekkert M.	2018	Barriers to the Circular Economy: Evidence From the European Union (EU)	Ecological Economics	150	30
Mutezo G.; Mulopo J.	2021	A review of Africa's transition from fossil fuels to renewable energy using circular economy principles	Renewable and Sustainable Energy Reviews	114	38
Masi D.; Kumar V.; Garza-Reyes J.A.; Godsell J.	2018	Towards a more circular economy: exploring the awareness, practices, and barriers from a focal firm perspective	Production Planning and Control	29	5,8
Silvestri C.; Silvestri L.; Forcina A.; Di Bona G.; Falcone D.	2021	Green chemistry contribution towards more equitable global sustainability and greater circular economy: A systematic literature review	Journal of Cleaner Production	23	7,7
Bastos Lima M.G.	2022	Just transition towards a bioeconomy: Four dimensions in Brazil, India and Indonesia	Forest Policy and Economics	22	11
Ho O.T.-K.; Gajanayake A.; Iyer-Raniga U.	2023	Transitioning to a State-Wide Circular Economy: Major Stakeholder Interviews	Resources, Conservation & Recycling Advances	19	19
Pactwa K.; Woźniak J.; Dudek M.	2021	Sustainable social and environmental evaluation of post-industrial facilities in a closed loop perspective in coal-mining areas in Poland	Sustainability (Switzerland)	15	5
Tan, J.; Tan, F. J.; Ramakrishna, S.	2022	Transitioning to a circular economy: A systematic review of its drivers and barriers.	Sustainability (Switzerland)	14	7
Pansera M.; Genovese A.; Ripa M.	2021	Politicising Circular Economy: what can we learn from Responsible Innovation?	Journal of Responsible Innovation	12	4

Table 2.2 most influential authors

2.3.2 Content analysis of the selected papers: Drivers and barriers to the just CE transition

The typical economic model of "take-make-use-dispose" needs to urgently be replaced by new socio-economic paradigms able to reduce the environmental and social harmful effects (Ghisellini et al., 2016; Murray et al., 2017). This linear economic model mainly focuses on output production without considering issues related to natural resource utilization, greenhouse gas emissions, and waste generation, substantial contamination and pollution of water, air, and land (Ho et al., 2022). Moreover, such a traditional model has been proven inadequate in supporting sustainable development (Ghisellini et al., 2023; Ghisellini et al., 2016).

In order to tackle these issues, CE emerges as an essential condition to ensure a sustainable future. This new economic model has currently gained increasing attention from policymakers, academics and organizations, leading to the development of several different definitions (Suarez-Visbal et al., 2022; Kirchherr et al., 2017). In this chapter, CE is defined as an economic model that privileges strategies aimed at achieving sustainable development by reducing, recycling, and reusing materials in value chain processes, supporting environmental quality, economic wealth and social equity (Kirchherr et al., 2017).

According to the literature, the crucial focus of CE remains mostly on value creation processes through better management of material resources and production processes, neglecting the related social impacts (Kirchherr et al., 2017; Mies and Gold, 2021; Pla-Julian and Guevara, 2019; Padilla-Rivera et al., 2020). Unfortunately, without tackling simultaneously social and environmental issues, it is not possible to achieve a trully just and inclusive CE transition (Calisto Friant et al., 2020; Schröder et al., 2020a; 2020b) where a healthful economy and a safeguarded environment can and must coexist.

In line with this, further investigations about the social dimension of the CE appear to be necessary (e.g. Henry et al., 2023; Neves and Marques, 2022; Thapa et al., 2022; Ho et al., 2023). In fact, while there is existing research and European projects (e.g. JUST2CE project) on barriers and drivers to CE, the social justice perspective is still under-explored. Therefore, in order to tackle this issue, this chapter seeks to advance our understanding of the factors that facilitate (drivers) or hamper (barriers) a sustainable, inclusive, and just CE transition through a systematic literature review.

In line with the aim of the JUST2CE project, a barrier can mean an obstacle, regulation, or circumstance hindering the establishment of a fair and sustainable circular economy and society. On the contrary, a driver is a factor that positively contributes to and enables the establishment of just and sustainable circular economy approaches, models and practices.

As shown in **Tables 2.3** and **2.4**, a list of the main drivers and barriers for each actor of the socio-economic ecosystems was identified.

In particular, focusing on organizations, it is worth underlining that financial issues were identified as a critical barrier to a just CE transition, especially for small and medium enterprises (SMEs) (Ho et al., 2023). In fact, despite the long-term positive returns from CE implementation, organizations require short-term financial availability to initiate their CE transition and, thus, incorporate circular business models. Specifically, organizations facing budget constraints and limited cash flow need financial subsidies to finance the higher upfront or initial costs of CE initiatives (Kirchherr et al., 2018). Even though public grants and funding opportunities exist, the primary obstacles to access these funds are time constraints and lack of or scant awareness about these. Moreover, existing financial evaluation tools show some limitations in the assessment of CE project feasibility (Ho et al., 2023), which further limits the access to public grants to businesses.

Another critical barrier for organizations is represented by a hesitant organizational culture that prevents organizational changes necessary to implement circular business models (Kirchherr et al., 2018; Calisto Friant et al., 2023). Moreover, the adoption of a traditional organizational structure posed further hurdles for CE transitions, even when there was awareness and motivation to integrate CE practices into their businesses. Specifically, traditional organizational structures characterized by silo-thinking approaches may not support collaboration among internal and external stakeholders, representing a critical lever for circularity. The lack of collaboration and knowledge sharing within an organization could further lead to an insufficient or limited understanding of CE initiatives, which could hinder the development of a CE mindset and strategies. Additionally, as the literature suggests, creating a supportive environment for top management to view CE favourably is crucial in transitioning organizations toward a just CE (Calisto Friant et al., 2021). Notwithstanding, it is worth underlining that the full understanding of CE initiatives depends on individuals' background, education level, and ages, as well as their interactions with the environment and their role within an organization or community.

As noted by Thapa et al. (2022), the just CE transition within an organization is driven by economic evaluations rather than environmental and social ones. In fact, organizations recognize economic aspects, such as financial benefits, cost savings (e.g., cost differences between reused/recycled materials and virgin materials, energy efficiency, etc.), and job opportunities as the most crucial elements underpinning the concept of CE and its implementation. Unfortunately, focusing only on economic aspects could easily lead to the failure of CE initiatives (Ghisellini et al., 2023). As suggested by Thapa et al., 2022, organizations must focus on social and environmental benefits, aligning with the concept of regeneration to support CE implementation properly.

In addition, several studies show a lack of indicators able to consider and assess all three aspects of the circularity, namely environmental, economic, and social (Calisto Friant et al., 2023). In particular, as outlined by Purvis and Genovese (2023), the existing indicators and measuring systems/methods focus mostly on economic and environmental dimensions with little attention to social ones. Therefore, the development of indicators and measuring systems that are also able to consider the social dimensions of CE initiatives appears to be crucial for favouring just CE implementation.

Focusing on consumers, the main barrier is represented by the lack of customer awareness, engagement, and interest, as well as behavioural resistance (Calisto Friant et al., 2023). In particular, such a situation could hinder the adoption of eco-conscious purchasing and, thus, induce behaviour resistance, reducing the consumers' propensity to buy CE products (Papamicheal et al., 2023). In line with this, it is worth underlining the necessity of breaching social stigma around second-hand products that might further reduce people's propensity to purchase sustainable products (Ho et al., 2023). Another way to try to increase consumers' willingness to use sustainable products is to reduce the so-called green premium. Generally, according to Tan et al., 2022, it is vital to improve consumers' perceptions of sustainable alternatives and reduce the green premium to boost the implementation of a just CE transition. Consumers have to know that by buying sustainable products, they are contributing to a more sustainable future. Moreover, several studies claimed that a high level of wealth is negatively related to purchasing second-hand products as wealthier families are less inclined to recycle, re-utilize and buy products containing a percentage of recycled inputs (Neves and Marques, 2023). In this case, increasing customers' awareness and liability about environmental justice and protection appears to be fundamental.

The lack of proper regulations and public measures is very critical in preventing the implementation of a just CE model (University Autonóma of Barcelona, 2023D2.2 of JUST2CE project; Bastos Lima, 2022; Nagarajan, 2022; Purvis et al., 2023). In particular, one of the main barriers discussed in the literature regards the implementation of CE initiatives without enough democratic participation, transparency, and citizen engagement (Calisto Friant et al., 2023; Masi et al., 2018; Schröder and Barrie, 2022; Katajamäki, 2023). This represents a significant barrier as this further exacerbates the tendency to pay greater attention to technological and practical aspects in the transition to the Circular Economy with negative sustainability implications (Pansera and Genovese, 2021) as technology cannot effectively address, for instance, the biophysical limits of the natural environment (e.g., limited natural resources, the limited capacity of the environment to receive waste and other substances emitted by human activities). On the contrary, by democratisation, citizens could better understand a variety of institutional, social, economic, cultural, political, educational, and organizational tools, innovations, and approaches that enable their inclusion and empowerment to decide about their society and the much-needed circularity transition. Specifically, initiatives promoting circularity, implemented through a top-down approach with an emphasis on technical solutions often resulted in various socio-ecological consequences, such as poor working conditions, social discrimination, and scant social interest affecting nearby ecosystems and communities. This means that public administrators should strongly consider supporting just CE transition in their policy-making processes. In particular, policymakers should enact new regulations to favour a just CE transition through social and economic incentives.

Table 2.3 Main barriers to a just CE transition

Stakeholder	Barriers	Previous studies
Organizations	Financial issues/initial costs	*Kircheer et al., 2018; Ho et al., 2023*
	Extreme focus on profits and economic growth	*Thapa et al., 2022*
	Hesitant organizational culture	*Kirchher et al., 2018*
	Traditional organizational structures	*Ho et al., 2023*
	Lack of full understanding of CE or limited understanding of CE by management	*Ho et al., 2023*
	Exploitation, poor working conditions, and discrimination (based on gender, class, education, race, ethnicity, origin, belief, age, ability etc…)	*Purvis et al., 2023; Tapha et al., 2022; Vanacker et al., 2023 ; Martínez Álvarez and Barca, 2023; Meira et al., 2023; Guillibert et al., 2022*
	Lack of measuring systems/tools	*Neves and Marques, 2023; Purvis and Genovese, 2023; Pactwa et al., 2021*
Consumers	Lack of consumer awareness, engagement and social responsibility	*Kircheer et al., 2018; Papamicheal et al., 2023*
	Behavioral resistance	*Papamicheal et al., 2023*
	Green premiums that consumers have to pay for sustainable alternatives	*Tan et al., 2022*
	Social stigma around second-hand products	*Ho et al., 2023*
	Lack of education on circularity and holistic understanding of socio-ecological impacts	*Barrie and Schröder, 2023; Papamicheal et al., 2023*
	High level of wealth	*Neves and Marques, 2023*
Policymakers	Lack of synergistic governmental interventions	*Nagarajan, 2022; Purvis et al., 2023*
	Lack of environmental enforcement	*Bastos Lima, 2022; Mohamed, 2018*
	Hegemonic technocentric path	*Pansera and Genovese, 2021; Purvis et al., 2023*
	Top-down initiatives and lack of democratic approaches	*Masi et al., 2018*
	Lack of economic incentives and organizational policies	*Ho et al., 2023*

Table 2.4 shows the main drivers identified in the literature. Regarding organization, the collaboration/participation with internal and external stakeholders represents an important lever for a just transition. For example, collaborating with stakeholders in supply chains was deemed crucial for managing the life cycle of products and materials and extending their lifespan. Again, horizontal management practices and worker-owned cooperative production structures, where economic decisions about what and how to produce are taken inclusively and democratically, could support employees' awareness about CE transition, as well as improve their worker conditions (Calisto Friant et al., 2023; Katajamäki, 2023; Mohamed, 2018; Purvis et al., 2023; Valencia et al., 2023; van Langen, 2021; Guillibert et al., 2022).

The development of new circular business models and strategies is a relevant step that organizations must take in order to enable a just CE transition (Calisto Friant et al., 2023; Papamichael et al., 2023). In line with this, a holistic business model approach is the proper way to enable the implementation of CE practices.

Regarding consumers, an important drivers for a just CE transition is the introduction of an income tax regime for individuals purchasing products containing a substantial amount of recycled components/materials (Neves and Marques, 2022; Ho et al., 2023). This could represent an effective strategy for enhancing the attractiveness of such products among high-income earners. This approach not only incentivises consumers to choose items contributing to the CE but also motivates businesses to adopt innovative production processes and meet the demand for products with a significant proportion of recycled materials (Ho et al., 2023).

According to the literature, CE education is recognized as an essential driver to aid the development of a new mindset, behaviours, and willingness to use sustainable products. In general, education can be a key driver for the entire production and consumption ecosystem as it can increase sustainability awareness and knowledge among all the actors involved (Ho et al., 2023; Ibáñez et al., 2023). In line with this, several studies show that there is a positive relationship between education level and environmentally sustainable behaviours, as well as just CE implementation (Neves and Marques, 2022). Furthermore, individuals with a tertiary level of education seem to be more aware of environmental issues and, consequently, more willing to adopt environmentally friendly behaviours (Cerqueira-Streit et al., 2021). Based on this, revising the educational curricula and training activities appears necessary to address the new societal and organizational requests.

In light of this, policymakers should formulate policies targeting segments of society with lower educational levels (Gromek-Broc, 2023; Ibáñez et al., 2023). Furthermore, advancing the adoption of democratic principles could make decision-making processes more transparent and increase citizen engagement and awareness (Švarc, 2022). Financial incentives or economic bonuses for consumers and organizations could contribute to fostering a more sustainable consumption and production system (Ho et al., 2023; Mohamed, 2018).

Therefore, regulations must be defined considering social and economic motivations and specific demographic features, such as the elderly, lower educational level, and wealth status (Švarc, 2022).

Table 2.4 Main drivers to the just CE transition

Stakeholder	Drivers	Previous studies
Organizations	Collaboration/Participation among different stakeholders (multi-stakeholder approach)	*Purvis et al., 2023; Valencia et al., 2023; van Langen et al., 2021*
	Adoption of CE business models and Strategies, as well as the development of social initiatives	*Papamichael et al., 2023; Silvestri et al., 2021*
	Enhancing social empowerment and worker rights and fostering horizontal management practices	*Thi-Kieu Ho et al., 2023; Katajamäki, 2023; Mohamed, 2018*
Consumers	"tax regime" that incentivises sustainable consumption	*Neves and Marques, 2022; Ho et al., 2023*
	Education	*Ho et al., 2023*
	Consumers' awareness, expectations and preferences	*Ho et al., 2023*
Policymakers	Social and environmental regulations	*Gromek-Broc, 2023*
	Advancing the democratisation of political spheres; transparent decision-making processes/citizen engagement.	*Schröder and Barrie, 2022; Katajamäki, 2023*
	Protectionist policies to support sustainable practices	*Kirchherr et al., 2018; Švarc, 2022*
	Financial subsidies	*Mohamed, 2018; Ho et al., 2023*

In a nutshell, policymakers must design policies that motivate all actors of the socio-economic systems to implement effective CE strategies, given that the transition to a just CE is contingent upon their involvement.

2.4 Concluding remarks

The circular economy has emerged as a pivotal component in various government policies, organizational strategies, and social initiatives. However, there is still a need for a deeper and more holistic understanding of the actual forms of CE implementation and the related potential impacts, especially at the social level. In fact, although some research on CE barriers and drivers exists, it has often been limited to specific contexts, countries, or industries and without employing a proper social lens for analysis.

Our contribution thus seeks to improve our understanding of the drivers and barriers to an inclusive, sustainable, and just CE transition through a social justice and sustainability perspective. In particular, the set of barriers (Table 3) and drivers (Table 4) could aid academics, policymakers, and practitioners in comprehending systemic issues hindering a just transition and in identifying possible solutions to overcome each issue.

One critical finding is the identification of three different key factors that could facilitate or hinder just CE transition and implementation through their actions and decisions, namely Organizations (private and public), consumers and policymakers.

Focusing on the results, it is possible to underline that the lack of democracy within the governance sphere (but also at the organizational level) represents a significant barrier to a just CE transition. The lack of citizen/consumer participation can be a major obstacle, given that they often possess a more ecologically holistic and socially justice-oriented understanding of circularity (Calisto-Friant, 2019). Additionally, organizations and policymakers could impose a technocentric vision of CE (Pansera and Genovese, 2021; Purvis et al., 2023). Technocentric approaches could fail to support an inclusive and sustainable transition, in particular, leading to socio-ecological impacts such as poor working conditions, social discrimination, and pollution. Democratic participation and citizen engagement involve various institutional, social, economic, cultural, political, educational, and organizational tools, innovations, and approaches that empower citizens and workers to actively shape their society and facilitate the essential transition to circularity (Calisto Friant, 2019). Hence, promoting transparent and democratic decision-making, both in the workplace and in public institutions, could ensure a fairer distribution of associated costs and benefits, as well as lead to more sustainable decisions and outcomes compared to traditional top-down governance processes (Katajamäki, 2023; Schröder and Barrie, 2022; Ho et al., 2023). Specifically, democratization and bottom-up decision-making approaches have the potential to ease the definition and implementation of crucial circular economy policies. This approach could facilitate, for instance, the implementation of labour policies to improve working conditions and income levels and reduce social discrimination (Ho et al., 2023). It may lead to new organization regulations requiring transparent disclosure of businesses' social and environmental performance. Moreover, citizen engagement in policymaking processes could lead to the definition of more appropriate redistributive policies that impose taxes on the wealthiest sectors to fund essential public services, generate employment, and cultivate economic opportunities in sustainable sectors. Finally, democratising decision-making processes within businesses is a crucial lever for improving worker empowerment, working conditions, and wages (Calisto Friant et al., 2023; Ho et al., 2023; Katajamäki, 2023; Mohamed, 2018). Such organizations often possess horizontal management practices, cooperative production structures owned by workers, and democratic governance structures rooted in bottom-up decision-making (Ho et al., 2023; Katajamäki, 2023).

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Chapter 3. A Framework to Critically Understand the Multidimensional Social Justice Implications of a Circular Economy Transition

Martin Calisto Friant, Maddalena Ripa, Mario Pansera, Tess Doezema

Abstract

Despite its growing popularity among politicians, business leaders, and academics, the concept of Circular Economy (CE) faces key criticism and challenges. Indeed, hegemonic visions of CE are narrowly focused on decoupling economic growth from environmental degradation through technological innovations. Yet these approaches lack reflection on the ethical, political, social, and cultural dimensions of the concept and especially the implications of CE for the most vulnerable citizens of the world, such as workers, farmers, and miners in the GS. As questions of social and environmental justice remain unanswered by the literature, CE policies might end up replicating current patterns of gender, racial and class discrimination and exploitation. Answering these challenges requires establishing a comprehensive conceptual framework to critically understand the multidimensional social justice implications of a CE transition. This chapter addresses this gap by building such a framework combining a multiplicity of different academic fields such as Science and Technology Studies, Feminist Ecological Economics, Political Ecology, Decolonial Studies, and Degrowth. The resulting multidimensional framework expands and builds on the 4 pillars of the concept of Technologies of Humility (framing, vulnerability, distribution, and learning). It thereby provides an epistemological, theoretical, and methodological scaffolding to help us address the ethical questions related to the future of CE and the societal implications of a CE transition.

Keywords: circular economy; conceptual framework; sustainability; environmental justice; technologies of humility.

This chapter develops a comprehensive conceptual framework to critically understand the multidimensional social justice implications of a circular economy transition. It does so by by expanding and building on the idea of Technologies of Humility and combining it with a multiplicity of different academic fields such as Feminist Ecological Economics, Political Ecology, Decolonial Studies, Responsible Research and Innovation, and Degrowth.

3.1 Introduction

The CE has risen from a little-known concept to become a major pillar of the European Green Deal and EU policies related to sustainability. CE promises to replace the current linear economic model with a new one that is restorative and regenerative by intention and design. Yet, the CE concept has come under criticism for focusing on economic growth and technological innovation and disregarding social justice implications. This means that CE policies might replicate current patterns of injustice, discrimination and exploitation along class, gender, race, colonial, and ethnic lines. Yet, there is still insufficient literature providing a coherent conceptual framework to understand the full complexity of social and environmental justice implications of a CE transition. This chapter seeks to answer this challenge by developing such a framework. It does so by expanding and building on the idea of Technologies of Humility and combining it with a multiplicity of different academic fields and theoretical approaches such as Feminist Ecological Economics, Political Ecology, Decolonial Studies, Responsible Research and Innovation, and Degrowth.

The chapter starts by reviewing the core criticisms of the mainstream approach to CE. It then develops a novel framework that addresses these limitations and enables the construction of a just approach to CE. The resulting framework is a comprehensive and adaptable conceptual model that allows academics and practitioners to better understand the social justice implications of a CE transition. It can thereby be useful to both critically reflect on current CE approaches and to develop future CE projects and policies with a holistic social justice lens.

3.2 Main Criticisms of the Circular Economy

Critiques of the mainstream approach to CE have come from many different academic fields, including economics, ecology, political sciences, sociology, and anthropology (Corvellec, Stowell, and Johansson 2021; Mah 2021; Skene 2018; Valenzuela and Böhm 2017). Overall, critics claim that mainstream CE propositions often have questionable premises and assumptions, as well as exaggerated positive outcomes.

The first critique pertains to the concept of CE itself, which has been defined as a “mix of various ideas from different domains” (Reike, Vermeulen, and Witjes 2018), an “umbrella concept” (Homrich et al. 2018) and “an overhyped and ill-defined concept” (Prendeville, Cherim, and Bocken 2018). By being a conceptual umbrella that covers a wide range of related concepts, the CE allows a variety of actors to slip under it and frame it in a way that suits them (Pansera, Genovese, and Ripa 2021). This ambiguity and diversity has been a key factor explaining the rising expansion of the concept in recent years, as many social, private, and public actors began embracing the CE in ways that best suited their interests and visions (Lazarevic and Valve 2017). While this opens the door to a plurality of different ideas and conceptualisations that may be deeply transformative, in practice, the mainstream vision of circularity has instead tended to be apolitical, technocentric, and reformist, especially when used by corporate and government actors (Calisto Friant, Vermeulen, and Salomone 2020a; Walker et al. 2021). The concept has thus often become associated with “the less than radical neo-classic economic theory and ecological modernization paradigm” (Corvellec, Stowell, and Johansson 2021), and as “a re-emergence of the mantra of cornucopians” (Giampietro 2019).

The second area of critique questions the achievability of the concept from a biophysical perspective. Several scholars argue that the promotion of the CE concept seemingly ignores that biophysical processes are subject to thermodynamic constraints and, therefore, no system can be 100% circular due to the laws of entropy (Giampietro and Funtowicz 2020). This means that recycling is not 100% efficient as materials and energy resources are inevitably lost in each use and recovery cycle (Korhonen, Honkasalo, and Seppälä 2018). Thus, despite advanced recycling and recovery technologies, the global share of recycled materials in total production of infrastructures, goods and services remains below 10% (Haas et al. 2020). Perfect circular loops are simply impossible, especially in an economic system that keeps growing, as recovered resources will not suffice to meet growing production demands (Skene 2018). The claim that we might be able to decouple economic growth from environmental degradation thanks to CE technologies and innovations is thus nothing short of a fairy tale (Giampietro and Funtowicz 2020). Indeed, over 50 years of evidence have demonstrated beyond any scientific doubt that we cannot decouple economic growth from environmental degradation on a scale and scope sufficient to prevent climate breakdown and biodiversity collapse (Haberl et al. 2020; Hickel and Kallis 2019; Wiedenhofer et al. 2020).

The third major criticism of the CE concept resides in the lack of consideration for socio-ethical issues (Suárez-Eiroa et al. 2019; Thapa 2023; Vanhuyse et al. 2021). Mainstream visions of CE are indeed narrowly focused on economic and technological dimensions, with a patent lack of reflection on political and socio-cultural implications as well as on the unintended consequences that a transition to circularity would entail on vulnerable people and communities (Suárez-Eiroa, Fernández, and Méndez 2021; Velenturf and Purnell 2021; Zwiers, Jaeger-Erben, and Hofmann 2020).

Transforming the linear economy, which has remained the dominant model since the onset of the industrial revolution, into a circular one is by no means an easy task. Such a radical change entails a major transformation of our current production and consumption patterns, which will significantly impact the economy, the environment and society. Any CE action, policy or practice is interwoven in social structures, political systems, as well as ideologies and imaginaries of socio-ecological change (Calisto Friant, Vermeulen, and Salomone 2023; Mah 2021; Zwiers, Jaeger-Erben, and Hofmann 2020). Alternative ways of thinking and organising society will result in different ways of redesigning our production and consumption systems, structures, and institutions. CE must be addressed in all this complexity, as a political and social concept, otherwise it might result in unintended social consequences that replicate or reinforce current patterns of discrimination, alienation, and exploitation along racial, class, gender, and other social lines (Millar, McLaughlin, and Börger 2019; Temesgen, Storsletten, and Jakobsen 2019).

The three above limitations can be evidenced in the implementation of CE in different arenas. The next section will showcase these limitations in the areas of governance (section 3.2.1), geopolitics (section 3.2.2), and labour and gender (section 3.2.3) to further explore the social, political, cultural, ecological, and ethical dimensions, complexities, and interdependencies of a CE transition.

3.2.1 The governance of CE

Many political actors at the local, national, and international levels have developed CE policies as a “win-win” solutions to resolve economic, social, and environmental challenges through green technologies and innovations (Petit-Boix and Leipold 2018). Yet this kind of technological optimism prevents a deeper understanding of the concept’s possible social justice and environmental sustainability implications (Moreau et al. 2017). Policies that may reduce the potential impacts of CE actions on vulnerable peoples and better distribute the costs and benefits of CE solutions are thus often excluded from the policy debate (Calisto Friant et al. 2023).

Many scholars have also questioned the type of governance and political regime that CE implies (Colombo, Pansera, and Owen 2019; Fratini, Georg, and Jørgensen 2019; Repo et al. 2018). The mainstream implementation of CE rests on a market-based governance approach focused on public-private-partnerships, voluntary agreements, market nudges and incentives instead of strict regulatory measures and constraints (Calisto Friant, Vermeulen, and Salomone 2021; Campbell-Johnston et al. 2020). This approach may increase recovery percentages for certain materials and incentivise the growth of new recycling businesses, but it will not fundamentally disrupt unsustainable industries nor reduce current patterns of over-consumption and over-production. The lack of democratic deliberation and meaningful citizen participation in the creation of CE policies and visions may be a critical reason for such a technocentric market-based governance. Research has found that CE policies are often developed by policymakers in coordination with industrial sectors, with little democratic citizen engagement and avenues for civil society participation (Arai, Calisto Friant, and Vermeulen 2023; Calisto Friant, Lakerveld, et al. 2022; Calisto Friant et al. 2023). This leads to a lack of pluralism in the debate and the imposition of a technocentric approach to CE, which does not align with citizen ideas and visions of CE (Calisto Friant, Vermeulen, et al. 2022; Lazarevic and Valve 2017; Repo et al. 2018).

3.2.2 The Geopolitics of CE

The dissemination and implementation of the CE concept has mainly taken place in the GN, and only a few studies have explored its implementation and interpretation in the GS[7] (Schröder, Anantharaman, Anggraeni, and Foxon 2019). This exclusion is inherently paradoxical as, in our globalised world, value chains and waste cycles are inherently international. Moreover, the global flows of resources from the GS to consumption centres in the GN and the subsequent export of wastes from the GN to the GS is a key linear, unjust and unsustainable structure of the global economic order, which remains unproblematised (Martinez-Alier 2021a). Indeed, the major driver for the overshoot of planetary boundaries today is the over-consumption of resources by the 10% of the global population that mostly live in the GN (Chancel 2021). The GS is thus used as both "resource extraction frontier" and a "waste disposal frontier" (Martinez-Alier 2021b) to allow the GN to perpetuate what Ulrich Brand calls an "imperial mode of living" (Brand 2022). In this context, the technocentric circularity and sustainability transitions in the GN are mostly about switching to renewable energy sources, which still require massive extraction of raw materials from the GS and perpetuate colonial relations of geopolitical power (Marín-Beltrán et al. 2022; Velasco-Herrejón, Bauwens, and Calisto Friant 2022). The scale of over-consumption and resource demand caused by the richest 10% of the global population is thus never challenged. Yet, under these conditions, circularity and sustainability will become a luxury only available to a few people in the GN who can access essential natural and technological resources (Schröder, Anantharaman, Anggraeni, Foxon, et al. 2019). Circularity must thus also consider the distribution of wealth, technologies and resources amongst countries around the globe and reduce the over-consumption of the richest inhabitants of the Earth, so that the rest of humanity may access the resources to meet their needs (Calisto Friant 2022).

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[7] By GN and South, we mean both a country-level distinction and a more nuanced socio-cultural distinction. In the country level distinction GN defines countries classified as "high-income economies" by the World Bank, while GS defined all other countries. In the socio-cultural distinction, we use the definition from Francis, who expands the idea of GS "to include not only nation states but also the people and spaces that racial capitalism positions as expendable in both the geographic North and South" (Francis 2021, p693). In this socio-cultural divide, the GN represents the 10% of elites, from any country, that consume over 50% of global resources and have a position of power over the global economy, while the GS, is the majority world, the 90% of the human population that are discriminated, exploited and alienated on class, gender, ethnic and racial grounds.

Another important geopolitical consideration is that current CE approaches focus on interpretations of the concept from the GN. Yet, circularity, as an idea to live in harmony with the natural cycles of the Earth, has existed for millennia in the GS (Calisto Friant, Vermeulen, and Salomone 2020b). The current GN-centred ways of imagining the CE inevitably silence indigenous discourses on circularity, which may bring inspiring ways of understanding and implementing CE in a transformative manner.

3.2.3 Labour, and gender

Social and ecological benefits from CE are often wrongly conceived as by-products of the transition and assumed to be achievable by simply decoupling economic growth from environmental impacts. Most empirical studies that assess social effects only underline the positive economic growth and employment effects in the EU and its respective Member States (Repp, Hekkert, and Kirchherr 2021). Beyond these uncertain estimates on employment, there is no further questioning of mainstream conceptualisations of work, including care work, or time use, nor mention of alternative patterns of consumption and production beyond the market rationale, e.g. experiences of sufficiency, de-/post-growth and communing (Hobson and Lynch 2016). High uncertainty surrounds the job market in the newly emerging CE. Broader patterns of globalisation, and demographic and technological changes will entail profound structural shifts in employment. This will fundamentally transform the type of work that is done, where it is done, and who it is done by.

Moreover, the gender dimension, and specifically reproductive and care work (conducted mostly by women and people of colour), has been widely neglected by CE studies. Since social reproduction and care are fundamental dimensions of the economy and key drivers of ecological transformation, there is also a need to understand how the social actors performing this work can contribute to the design and implementation of CE (Morrow and Davies 2021; Pla-Julián and Guevara 2019). Indeed, essential CE activities such as repair cafés, community composting, reuse networks, tool libraries, household maintenance, and urban agriculture are part of the under-valued and under-recognised care economy, in which women and people of colour bear the largest work burden.

3.3 Towards a Just Circular Economy based on humility

To respond to the criticisms explored in the previous sections, we offer a novel multidimensional framework that seeks to assess the social justice implications of a circularity transition. The framework embraces a "humble" approach to knowledge. Humility is associated with uncertainty and pluralism. The higher the uncertainty, the more humility we ought to apply to it. Based on this humble approach, we recognise that knowledge of the world is always interpreted, structured, and filtered by the observer. We thus call for other ways of 'knowing' beyond Western epistemologies and worldviews.

Specifically, we draw on the STS (Science and Technology Studies) concept of Technologies of Humility (Jasanoff 2003). This concept helps us pose "the questions we should ask of almost every human enterprise that intends to alter society: what is the purpose; who will be hurt; who benefits; and how can we know?" (Jasanoff 2003, p240). Technologies of humility are presented as a counterbalance to what Jasanoff refers to as the modern reliance on "technologies of hubris"—a command and control approach to science and technology that seeks to clear the way for science-driven innovation (Jasanoff 2003). "These technologies compel us to reflect on the sources of ambiguity, indeterminacy and complexity. Humility instructs us to think harder about how to reframe problems so that their ethical dimensions are brought to light, which new facts to seek and when to resist asking science for clarification. Humility directs us to alleviate known causes of people's vulnerability to harm, to pay attention to the distribution of risks and benefits, and to reflect on the social factors that promote or discourage learning" (Jasanoff 2007, p33).

To this end, Jasanoff proposes four pillars for realising Technologies of Humility: framing, vulnerability, distribution, and learning. Together, these provide a scaffolding for the ethical questions we should be asking about the future of CE and are the basis of our multidimensional framework (**Table 3.1**).

The four dimensions encompassed by Technologies of Humility must not be conceived as silos. As made explicit by the partial overlapping of leading questions, these dimensions are not disjointed and compartmentalised. Instead, they reflect the collaborative and transdisciplinary exercise of recognising interdependencies among issues and research fields.

Table 3.1 Multidimensional Framework to Critically Understand the Social Justice Implications of a Circular Economy Transition

Humility Pillars	Leading Questions	Research Approach and Fields
Framing	What kinds of broader understandings of the world shape how CE is understood and mobilised?	Science & Technology Studies (STS) Organisation Studies (OS) Institutional Theory (IT)
Vulnerability	Whose voices and interests are heard, and whose voices and interests are neglected?	Decolonial Studies (DS) Feminist Ecological Economics (FEE) Feminist Political Ecology (FPE)
Distribution	How are the costs, benefits and opportunities of CE distributed at different scales and among different social realities?	Environmental Justice (EJ) Political Ecology (PE) Ecologically Unequal Exchange (EUE) Degrowth
Learning	Are people mobilising alternative imaginaries in their desirable transition?	Responsible Research and Innovation (RII) Post-normal Science (P-NS) Future studies (FS) Transdisciplinary and Participatory Action Research (TPAR)

3.3.1 Multidimensional Framework on the Social Justice Implications of a Circular Economy Transition

Following Jasanoff's Technologies of humility, Framing comes first.

3.3.1.1. Framing

As stated by Sheila Jasanoff "If a problem is framed too narrowly, too broadly, or simply in the wrong terms, then the solution will suffer from the same defects" (Jasanoff 2018). Section 2 showcased how, depending on the case and context, CE is open to a variety of competing interpretations, interests, and governance regimes. The concept of framing has been articulated and developed by a wide range of academic disciplines (Cornelissen and Werner 2014). We draw on the definition of framing as "the processes through which actors seek to impose interpretations and order upon an ambiguous social world" (Hajer and Laws 2009).

Competing CE framings are embedded in larger institutional contexts and practices and influenced by different assumptions and visions of socio-ecological change (Calisto Friant 2022). It is thus important to scrutinise CE discourses regarding both their rationale and goals of the transition and the governance and technological configurations proposed to achieve them. The latter are particularly important as they can empower or silence certain actors depending on who is included and who has a voice and a vote.

Societal institutions and organisations are central in the basic framing of CE as they set the normative, contextual, cultural, and cognitive constraints around which CE is debated. Understanding institutions requires attending both to their internal structures and to the bidirectional nature of institutional processes as they influence and are influenced by a wide range of societal actors, including other institutions (Purdy, Ansari, and Gray 2019). Borrowing from institutional theory, it is vital to analyse the three institutional pillars that shape CE framings (Scott 2010):

1. Regulative: formal institutions that enable/hamper CE practices like national/international regulation, laws, rules, sanctions systems, etc.;
2. Normative: socially accepted behaviour that favours or encumbers the implementation of CE practices, such as social and moral obligations, binding expectations, etc.;
3. Cognitive: institutions that are taken for granted, such as shared understandings, worldviews, and common beliefs (including gender bias and anthropocentrism).

Based on the above reflections, the key questions that guide the "framing" dimension of a just CE transition include:

- How are organisations and institutions framing CE?
- Who advocates for CE, which narratives are they using, and which factors do they consider supporting or hindering its successful adoption?
- How do different framings of CE shape different forms of implementation (i.e., governance)?
- How are different institutional pillars (regulative, normative, cognitive) shaping different framings of CE?
- How is the concept of CE re-appropriated and re-articulated in different contexts?

3.3.1.2. Vulnerability

Vulnerability is understood as a situation in which a person or a group of people are more likely to be harmed and/or not having her/his/their interests justly considered. Often, vulnerability is taken as an objective phenomenon that can be measured with specific indicators (Vardy and Smith 2017). However, it is probably more informative to pay attention to the processes of vulnerabilization, in which the other is made or kept vulnerable. Vulnerability is intimately interwoven with epistemic injustice, which refers to the silencing of voices, especially those most marginalised and disempowered from economic, social and political power (Fricker 2007). Silenced people become vulnerable in a CE transition if they cannot voice their concerns and have their needs heard and met. The deep societal transformations at play in a CE transition might end up worsening the discrimination, marginalisation, and exploitation of such silenced populations. Including vulnerability in this framework thus means giving a central place to values, understandings, practices, narratives, and actors at risk of being unnoticed, underplayed, unheard, or misrepresented by the CE transition.

It is important to give particular attention to the marginalisation of knowledge systems not aligned with the Western scientific canon, like indigenous worldviews from the GS. This has been at the core of decolonial and postcolonial scholarships (Escobar 2018; Jimenez and Roberts 2019; Velasco-Herrejón, Bauwens, and Calisto Friant 2022). Decolonial thinkers have argued that the universal imposition of Western knowledge has resulted in "epistemicide", by which traditional cultures and worldviews in the GS have been destroyed, oppressed, and silenced to make way for "modernity" (Escobar 2008; Mignolo 2007; Rivera Cusicanqui 2012; Walsh 2007). It is thus crucial to contest and subvert the unquestioned universality and superiority of Western society, worldviews, and science by empowering and giving voice to marginalised peoples (Fals-Borda 1987).

Feminist Ecological Economics and Feminist Political Ecology scholarships have pointed out the problematic dualisms rooted in Western culture (and in capitalism), which present hierarchical ontological divisions such as civilised vs savage, mind vs body, human vs nature, male vs female (Barca 2020; Plumwood 1993). Dualist thinking divides the world into bifurcated hierarchies and is inherent to all forms of oppression and domination. Following the binary logic, "humanity" comes to be identified with a white male subject of History, pertaining to the capitalistic sphere of science, technology and industry, while "nature", "women" and "savage" are identified with a devalued and passive "reproductive" sphere (Barca 2020). The global socio-ecological crisis can be seen as the outcome of this dualist capitalist, anthropocentric, and patriarchal system of division that treats both women and nature as "resources" to be exploited (Dengler and Lang 2021).

Both women and people of colour are more likely than white men to provide unpaid care (reproductive and subsistence work) and communing work - e.g., transmitting care practices and responsibility for human and more-than-human ecosystems (Dengler and Seebacher 2019; Guillibert, Barca, and Leonardi 2022). These practices are often crucial for CE as they enable non-commodified circular loops such as repair networks, tool libraries, community composting, local support groups, cooperative childcare, urban agriculture, ecosystem conservation and regeneration etc. (Morrow and Davies 2021; Pla-Julián and Guevara 2019). In short, it is key to recognise "the forces of reproduction" that sustain production, and the role of reproductive care work in the daily regeneration of human and more-than-human life (Barca 2020).

The key questions that guide the analysis and understanding of the "vulnerability" dimension of a just CE transition include:

- Whose voices and interests are heard, and whose voices and interests are neglected?

- How can we ensure that all voices are heard, especially the voices of marginalised and vulnerable people and those with non-Western perspectives and worldviews?
- How are relations within CE shaped by historical processes of dispossession (like colonialism, extractivism, and land grabbing) and by gendered divisions of labour?
- How do gender, class and racial relations shape work conditions, innovation, and organisational conditions in CE initiatives?
- What is the role of women (and reproductive care work more broadly) in the CE?
- How can we identify, name and value reproductive care work wherever it occurs in CE initiatives?

3.3.1.3. Distribution

When transitions towards more sustainable futures are envisioned, distributional aspects (who gets what environmental benefits and burdens) must be considered from a global, planetary-boundary perspective. Considering the harms and benefits of these transitions, critically examining who is (and who is not) part of these processes, who wins and who loses, and recognising the historical exclusion of peoples and worldviews is essential to ensuring that system transitions are not only more sustainable but also more just. In short, there is a need to understand "who defines what is just, and for whom" (Newell and Mulvaney 2013) and how these questions are related to existing power structures in different contexts.

The distribution of benefits and burdens of a CE transition has two key dimensions: geographical (i.e., distribution between different countries, regions, and cities) and social (i.e., distribution between different social groups).

The geographical dimension closely relates to the concept of Ecologically Unequal Exchange, developed in academia and particularly in Ecological Economics (Hornborg and Alf 1998; Muradian, O'Connor, and Martinez-Alier 2002) and Degrowth (Hickel et al. 2022) as a challenge to mainstream economic theories of trade. Ecologically Unequal Exchange claims that consumption and capital accumulation in the GN is based on environmental degradation and extraction in the peripheries (the GS). Geopolitical factors, especially the structure of international trade, shape the unequal distribution of environmental harms and economic benefits so that wealthier nations have a disproportionate access to both natural resources and sink capacity for waste in poorer nations (Dorninger et al. 2021; Frey, Gellert, and Dahms 2018; Givens, Huang, and Jorgenson 2019). By externalising environmentally damaging production and disposal activities to countries in the GS (burden-shifting), countries in the GN can enlarge their domestic carrying capacity (i.e., stocks of natural resources that yield important goods and services as well as its sink-capacity - waste assimilation properties of ecological systems) (Ripa, Di Felice, and Giampietro 2020). Environmental Justice and Degrowth scholars have described such displacements as a continued form of colonialism and ecological debt (Hickel et al. 2022; Hornborg and Martinez-Alier 2016; Singh 2019). It is important to acknowledge these structural global asymmetries when analysing or developing any CE activity in the GN or South, and respond to these injustices in a holistic manner.

Another key geographical aspect that is rarely discussed is the fact that the re-localisation and reduction of overproduction that CE entails might affect current production and waste disposal industries in the GS. If a truly sustainable CE approach succeeds in reducing the use of raw materials, it would also reduce the demand for raw materials from the GS. While the re-localisation of industries and the reduction of material extraction have positive impacts on society and the environment, they will have different consequences for different people. Therefore, alternative sources of income must be created for industries and people in the GS who risk losing their jobs. Technology transfer and financial aid may be key in this regard, as they can allow countries in the GS to re-direct their production capacity to make goods and services that are needed for their own socio-ecological well-being (Calisto Friant, Doezema, and Pansera 2023). These questions are crucial to better understand the distributional impacts of a CE transition in one country for other countries; and to help plan an inclusive CE that leaves no one behind.

The social justice dimension of distribution relates to questions of access to essential resources and opportunities for people in the GN and South alike. As CE transitions will require large-scale changes to infrastructure, technology, and socioeconomic frameworks, it is key to question the economic and social implications for businesses, local communities, and the millions of individuals directly or indirectly employed in the supply chains that the CE aims to transform. Miners, farmers, suppliers, informal waste collectors and other key actors and workers in the supply chain must radically change their practices towards sustainable and regenerative CE approaches (Guillibert, Barca, and Leonardi 2022). It is thus essential to be critical regarding the distribution of costs and benefits in this transition and to question who pays, and who profits from CE, and how can current injustices be redressed. Important considerations in this regard include the availability of sufficient quality jobs at all skill levels and the accessibility and affordability of CE products and services (Berry et al. 2021; Clube and Tennant 2023; Schröder, Lemille, and Desmond 2020). Ownership of CE industries and technologies is also crucial, as it can affect the distribution of benefits and the diffusion of new innovations (Calisto Friant, Vermeulen, and Salomone 2023). Cooperative and communal forms of ownership might provide unique opportunities to improve democratic decision-making on the CE transition for companies and ensure quality jobs and sufficient incomes. Indeed, non-profit cooperatives may offer an alternative approach to CE, which places social and ecological well-being above profits and economic growth (Villalba-Eguiluz et al. 2023).

The key questions that can guide the understanding and analysis of the “distribution” dimension of a just CE transition include:

- How are the costs, risks, benefits and opportunities of CE distributed at different scales and among different social classes and realities?
- What transformations will CE bring to different peoples/workers and social groups? How can this transformation be more socially just and inclusive?
- How can the CE benefit workers and communities whose livelihoods currently depend on linear industries (fossil fuels, fast fashion, industrial agriculture)?
- How do formal CE initiatives affect informal sector circularities, such as informal waste scavengers and waste pickers?
- What types of capacity-building, skills development, social protection, and inclusive, participatory processes can make a CE transition more just?
- Why does the CE occur in one place and not in another?
- Who has access to funds related to the promotion of CE, and who is excluded from this funding?
- Could CE disrupt geopolitical arrangements and trade relations? What new extraction, production, and recovery economies will be created by CE, and where will they take place?
- What could happen if the GN re-localises its production or reduces demand for raw materials? How can the GS redirect its production to meet local needs and demands?
- How can more fair and sustainable trade relations be established to foster a just CE transition in the GN and South alike?

3.3.1.4. Learning

Investigating the implications of CE is crucial, but it is also essential to question how this research and learning takes place. Scientific institutions have systematically failed to examine which values are important, and whether these can be universally applied across countries, continents and cultures (Macnaghten et al. 2014). This realisation has led to calls for new ways of doing science that actively engage with different types of knowledge in a participatory manner (Adelle et al. 2019; Funtowicz and Ravetz 1993; Pereira and Funtowicz 2015). Building upon this focus on (co-)learning, we refer to the importance of public dialogue to open up CE frameworks to the pluralism of visions on a CE transition and to better understand and explore associated ethical issues, dilemmas and possible impacts (intended or unintended). We acknowledge that communities that are impacted by a phenomenon have unique forms of expertise that should be integral to how the phenomenon is understood and ultimately addressed. Capturing different perspectives and ideas on CE in a participatory approach to knowledge production, assessment and governance is hence essential to co-create desirable CE futures (Guimarães Pereira and Saltelli 2017).

The term "co-production", as well as the variety of related concepts and labels including science-policy interface, democratization of expertise, knowledge brokering, and responsible innovation, have gained traction in debates about climate knowledge in general and climate adaptation more particularly (Lemos and Morehouse 2005; Visbeck 2007; Ziervogel, Archer Van Garderen, and Price 2016). In our interpretation of co-learning, citizens and stakeholders are not seen as passive users or beneficiaries of goods and/or services contributing to their success or failure (Sorrentino, Sicilia, and Howlett 2018). Rather, they are necessary active elements of a 'new participatory governance' aiming at democratic and critical deliberation. Co-learning is about social desirability and participation in defining the goals, purposes and motivations for a CE transition. By collaborating, researchers and practitioners can integrate different ways of knowing and developing actionable knowledge that contributes to effective, legitimate, and socially transformative solutions.

We propose an overall engagement strategy to understand how actors, at multiple geographical scales, conceive the benefits and challenges of CE in relation to community-based goals, and how they mobilize these imaginaries in their visions of the future. The approach of 'working with rather than on people' is central to Responsible Research and Innovation, which, among other things, emphasizes the need for bottom-up processes through mechanisms of deliberation and inclusion (Owen, Macnaghten, and Stilgoe 2012; Purvis, Celebi, and Pansera 2023). Similar approaches are proposed by academics in the fields of Transdisciplinary and Participatory Action Research, which call for inclusive and decolonial forms of knowledge-making that break disciplinary boundaries and place researchers and citizens as equal participants in the scientific process (Bauwens, Reike, and Calisto-Friant 2023; Eelderink, Vervoort, and van Laerhoven 2020; Vermeulen and Witjes 2020; Witjes and Vermeulen 2020). Those co-learning and co-producing methods and approaches can help give voice to marginalized and vulnerable voices and ensure that academic research doesn't end up replicating current patterns of injustice, exploitation and discrimination.

Key questions that can guide the understanding and analysis of the "learning" dimension of a just CE transition include:

- What is hindering the realisation of epistemological pluralism in CE initiatives?
- Are people mobilising alternative imaginaries in their desirable CE transition?
- How can we foster and empower the co-creation of desirable CE futures?
- What values and practices remain constant across different contexts, and what elements emerge from localised engagement?

- How to ensure the active engagement and participation of citizens in the co-creation of knowledge on a CE transition?

3.4 Conclusions

In this chapter, we presented the key criticisms and limitations of mainstream approaches to CE, and we proposed a multidimensional framework that can be used to better understand the social justice implications of a CE transition. The framework was successfully implemented by the JUST2CE project to analyse 10 diverse CE case studies in Europe and Africa (JUST2CE D2.2 2023) and to compare and contrast them (Calisto Friant, Doezema, and Pansera 2023). It can hence be used to analyse diverse cases of CE at different scales (from local to global initiatives), different institutional settings (formal/informal), different socio-cultural contexts (GN and South), and different industries and sectors.

When using the framework, it is essential to keep a decolonial and transdisciplinary focus. Indeed, the framework recognises that knowledge is always interpreted, structured, and filtered by the observer and calls for other ways of 'knowing' beyond Western epistemologies. We particularly call for its use through transdisciplinary and participatory co-production methods that subvert the silencing and misrepresentation of marginalised voices and perspectives and that assert the right of human beings to shape the knowledge about them, their communities, and their organisations.

Overall, this multidimensional framework could be valuable for practitioners and academics seeking to better understand the implications of CE implementation as well as to develop CE policies and approaches that are socially just and transformative. We particularly encourage its adaptation and use in different contexts in collaboration with local communities and diverse societal actors. This framework should be seen as a methodological and conceptual tool that can be discussed, criticised, improved, and continuously adapted to better reflect local socio-ecological conditions, realities, priorities, and aspirations.

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Chapter 4. Conditions and constraints for a just transition: definition and role of the social and justice dimension

Mufunde Tutsirai, Chinyepe Andrew and Cephas Mandizvidza

Abstract

This article shall highlight issues around social justice dimensions around the transition to a CE. Several organizations and institutions provide their own definitions for social justice and a few will be discussed in this abstract. The Department of Economic and Social Affair (DESA): Division for Social Policy and Development Social Justice under the United Nations in 2006 defined Social Justice as "the fair and compassionate distribution of the fruits of economic growth." The National Association of Social workers (NASW) in the United States of America in 2018 defined Social Justice as "the view that everyone deserves equal economic, political and social rights and opportunities". The social justice dimension has a big role for the achievement of a just transition to CE. There is need to explore social protection measures alongside policies to close material loops, provide support to develop national just transition plans, design and coordinate reskilling programmes and promote measures to ensure decent work. Enhanced citizen and stakeholder engagement is a way of introducing justice and equity dimensions in CE transitions and increasing social legitimacy.

Keywords: Circular economy, Social justice, Social dimension, Equity, Human rights

Some of the most important issues to consider in the transition to CE have a social dimension and if not explored the transition will be unfair. This is because some of the social justice issues involved in transitioning to CE have roots in existing inequalities and these must be explored so that they will not be exacerbated by the transition.

4.1 Introduction

CE models aim to reduce waste, reuse resources, and regenerate natural systems, creating a more sustainable; resilient way of producing, consuming goods and services. According to EU, the CE is a consumption and production model involving "sharing, leasing, reusing, repairing, refurbishing and recycling existing material and products as long as possible to extend the life cycle of the products (European Parliament, 2021). Ghisellini and Ulgiati (2020) claim that transition to CE is increasingly concerned with the need for achieving a sustainable development path in a world where population is expected to reach 9 billion people by 2050 (UNEP, 2018). More often than not, CE is considered as one of the solutions to the global environmental problems (Cristoni and Tonelli, 2018; Lieder and Rashid, 2016) than social problems. In support, Mies and Gold (2021), reported that the predominant focus of most circular economy-related approaches is, however, within the environmental and economic dimension, whereas social aspects, such as labour practices, human rights or community well-being, have only been peripherally and sporadically integrated into the circular economy concept. The question is how circular economy models can also promote social justice and inclusion, ensuring that no one is left behind or exploited in the transition to a CE.

Inclusiveness and social justice are fundamental issues that need to be addressed for a successful CE transition to achieve positive social-ecological outcomes. In order for a CE to deliver on essential goals like improved health, decent working conditions, reduced inequality; there is need to address the human and social dimensions of the transition. Social justice hinges on equality, equity, diversity, fairness, and human rights. The process promotes, supports, and ensures equal opportunities for all, irrespective of their social identities and context. Agyeman (2008), argues that sustainability discourse and practice usually leave out inequity and injustice, racism and classism and calls for "just sustainability".

It is pleasing to note that the prerequisite to address social issues in circular economy transitions, alongside environmental concerns and building the circular business case, is receiving more attention in the mainstream approaches and this chapter is going to be looking at the conditions and constraints for a just transition. University of Maine (2022), claim that, without consideration for the social dimension, such as what role labor plays in the system or ensuring inclusive representation in decision-making processes, the circular economy may not be as beneficial as its proponents claim it to be. This means there should be fairness and equal opportunities along all value chains of product development. All the pillars and principles of circular economy should be framed in the spirit of social justice. To achieve social justice in circular economy, there is need for just transition.

4.2 Social justice dimensions

4.2.1 Definitions

Conceptualizing the social justice concept requires unpacking the different meanings it has to people in different contexts (Sleeter 2014). In fact, social justice has been described as a vague concept that, while widely used, is under-theorized (Cochran-Smith 2010; North 2008). Scholars suggest that the varying understandings may be somewhat a reflection of how the concept of social justice is itself historically and politically constituted and used across a number of disciplines, which makes definitive meaning-making almost impossible. Shriberg and Clinton 2016, suggest that different cultural, contextual and situational aspects play into how social justice is understood in different societies; therefore, views of social justice are likely deeply rooted in the collective experience of those in a particular society. According to ILO, (2022), a post-carbon transition is just if it is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind, i.e. if it maximizes social and economic opportunities.

Classic political though on justice includes John Rawls' theory of justice, which argues that our behaviour is influenced by the institutions we create, and Nancy Fraser's three dimensions of social justice: Redistribution (of resources), Recognition (of marginalized groups) and Participation (of individuals and groups). Following these, many scholars have advocated that a just transition should amount to procedural, distributive and restorative justice (Newell & Mulvaney, 2013; McCauley & Heffron, 2018; Stevis & Felli, 2020). These developments reflect the gradual broadening of social justice as a practical ideal, now encompassing a number of themes and issues beyond basic rights and economic equality. In general, terms, social justice might be understood as a society that values fairness and equity for all individuals and social groups in all areas of life; that recognizes and respects differing ethnic, cultural, gender, and other identities among citizens; and, most importantly, that affords a dignified and fulfilling existence for all individuals.

4.2.2 Categories of social justice

University of Maine researchers (2022), divided justice definitions into four sub-categories:

- Neoliberal justice, which is achieved through individual actions and the free market;
- Procedural justice, which gives representation to all parties who have stake in the outcome of a decision-making process;
- Distributive justice, which centres on the fair distribution of benefits and harms; and
- Compensatory justice, which compensates communities that have been historically disadvantaged.

4.3 Role of social justice dimension

Justice, in terms of its scope, is not only a matter that addresses collectively public and social matters, which can be changed or altered, such as poverty and the sociopolitical marginalization of people. It also takes into consideration the well-being of individuals whether they are poor, marginalized, assaulted, or socially excluded (Vazquez-Brust & Campos, 2023). In circular global chains, the destruction of jobs and the creation of jobs may happen in different regions, even different countries, hampering traditional forms of redistribution and exacerbating geographical inequalities. This is common if one compares the benefits and challenges of value chains that involves GN and GS. As an example, in developed economies, Global Value Chains (GVCs) provide access to more competitively priced inputs, higher variety, and the economies of scale. For emerging economies GVCs are viewed as a fast track to industrialization. (Baldwin and Lopez-Gonzalez, 2013) cited in Raei et al., 2021.

Therefore, CE models need to be accompanied by social innovation, which is the process of developing and implementing new ideas that address social needs and challenges. Social innovation can help to design and deliver CE models that are more inclusive, participatory, and responsive to the needs and preferences of different groups and contexts. For example, social innovation can involve co-creating solutions with the users and beneficiaries of CE models, such as through participatory design, user feedback, or community ownership. Social innovation can also involve developing new business models, policies, or institutions that support and enable CE models, such as through social enterprises, cooperatives, or public-private partnerships. Social innovation can also involve creating new networks, platforms, or movements that advocate and mobilize for circular economy models, such as through campaigns and coalitions. According to Warren et al., (2020), corporate social innovations are designed to benefit firms and society. Through SI, citizens with reduced available resources (food, energy, water, and fabricated products) can develop innovative opportunities to satisfy their needs efficiently, achieve social and environmental goals and benefit from new capabilities, improved autonomy and self-reliance (Dodman et al., 2017; Manzini, 2015 as cited in Marchesi & Tweed, 2021.

Vazquez-Brust, D & Campos,l.S (2023) argue that integration of the social dimension in circular business models and projects does not come so naturally in a developed world context, which may explain the 'social gaps' in CE literature that mainly originates in western policy and academic circles. According to Corporate Finance Institute (CFI, 2023) Principles of social justice may include five main principles of social justice that are paramount to understanding the concept better: access to resources, equity, participation, diversity, and human rights.

4.3.1 Access

Equal access to social goods is one of the most fundamental principles of social justice. This holds that society's resources should be equally available to all. Social justice refers to the extent to which different socioeconomic groups receive equal access to give everyone an equal start in life. For example, many social justice theorists believe that people should have equal access to education, health care, and employment opportunities. Public servants can uphold this principle by ensuring that everyone has access to these resources. CFI (2023) postulates that equal access gives everyone an equal start in life. In a globally inclusive circular economy, jobs are decent, accessible and attractive to workers everywhere. However, this is not the case. Several small companies are involved in lower level of waste valorisation such cleaning and shredding of plastic waste in Africa, while advanced and valuable valorisation is carried out in developed countries, meaning an imbalance between the GN and GS. Where there is equal access, , just like in high-income countries, circular jobs in lower-income countries provide similar levels of security, safe working conditions and meaningful development and are equally valued across societies.

4.3.2 Equity

Equity is the principle that people should have the same opportunities to succeed, despite any past injustices or systemic discrimination. According to CFI, equity refers to how individuals are given tools specific to their needs and socioeconomic status in order to move towards similar outcomes. There should be equal opportunity irrespective of gender, the status of people in society, and whether they are living with a disability or not. There should be no discrimination of women from high-paying positions of the circular economy value chain. This may mean that resources are distributed in a way that addresses the specific needs of underprivileged communities or people; and the importance of equity resides, among other aspects, in improving human rights and social justice. This reflects the connectedness of the concept of social equity within interpretation of sustainable development aimed at satisfying the needs of present as well as future generations.

Kent State online added that to achieve social justice and ensure equal opportunities for success, it is important to provide equitable resources that focus on the specific needs of communities and the individuals within them. However, some scholars felt that there are some gaps in the literature on how CE promotes equity. Thus, it is necessary to create the tools and mechanisms that can adequately and accurately integrate the concept of social equity within CE discourse to progress in different directions, in this regard, further work is necessary in this area (Padilla-Rivera et al., 2020). On the one hand, Zhijun and Nailing suggest that the CE can incentivize economic and social growth, and that the implementation of the CE in certain areas has been associated with an important raise in GDP. They advocate the idea that GDP increment can be employed as an indicator for social equity. According

to the European economic and social committee, 2016, if resource efficiency were to be improved by 30%, possible savings could exceed EUR 600 billion annually, thereby providing a competitive boost to European industry.
But Van Den Bergh,2008 (as cited by Ghisellini & Ulgiati, 2020) argues that GDP is not sufficient for improving social equity. Therefore, as earlier indicated by Moreau et al. (2017), it seems that there is no agreement or conclusive knowledge about how CE could support the promotion of social equity. As a result, agreeing with Aston (2022), if CE is seen as a tool to move forward sustainable development, it must firstly develop a framework to show how CE strategies can promote/incentivize social equity, and it can be incorporated with other aspects (Rivera, 2020). However, as claimed by Moreau et al (2017), so far, there is no explicit evidence on how CE could lead towards social equity.

4.3.3 Diversity

Diversity is the principle that government and business leaders should be broadly representative of the communities they serve. This means that not only should there be women and people of colour in positions of power, but also that minority communities should be equally represented in public institutions (Mollenkamp, 2022). On a policy level, this principle may entail prohibitions on discrimination or providing resources in multiple languages. People living with disability are often ignored in circularity decision, a reason why more often goods and services are designed in such a way that they are not user-friendly to this constituency.
According to CFI (2023), understanding diversity and appreciating the value of cultural differences are especially important because policymakers are often better able to construct policies that take into consideration differences that exist among different societal groups. It is important to recognize that some groups face more barriers in society, and by considering the inequities, policymakers and civil servants will be in a stronger position to expand opportunities for marginalized or disadvantaged groups. Discrimination in employment on the basis of factors such as race, gender, ethnicity, sex, age, and other characteristics are constant issues in society, and enforcing policies to countermand discriminatory practices are one way in which diversity in CE can be taken into consideration.

4.3.4 Participation

Participation is the principle that everyone in a community should have a voice in making important decisions. According to Mollenkarmp (2022), in many societies, public policies are set by a small group of powerful people, without consulting the communities they represent. This may have the unintended effect of excluding a large part of the community. According to Rivera (2020). When society is allowed to participate, it gives diverse communities room to express their own opinions, and in some cases, they can influence decisions makings, such as circularity decisions. Rivera (2020) postulates that the understandings and outcomes from society's participation can play an important role in tackling persistent societal problems in a reasonable, transparent, and multi-oriented way, along with enabling innovations for circularity. Therefore, circular economy strategies should explicitly outline strategic and systematic approaches to bring all stakeholders, together, to attempt policy coherence.
All CE actors must be connected more closely with multi-perspective policy processes and intergovernmental discussions, and should be organized by a common perspective of a sustainable CE system. On the contrary, a study carried out by Amorim de Oliveira, (2021) concluded that waste pickers (on the lower level of waste valorisation) often are not included in decision-making about waste-related issues, despite the important role they

play. This is common in developing countries where workshops and meeting are carried out on waste management without involvement of stakeholders called waste pickers.
According to Rivera (2020), there are three levels of participation in terms of environmental and circular economy issues: participation in the planning process, participation via information, and participation in finance decisions. Different goals and scopes are pursued from the decision-making progress (Amorim de Oliveira, (2022), stakeholders' interest, and perceptions of bio economy (Zeug, 2019), to consumer perspectives on CE strategies for reducing wastes (Borello, 2017). These approaches have the power to give an insight base for short-term democratic and decision-making agendas (of incentives and measures to forward a potentially sustainable CE) as well as to put them into practice.

4.3.5 Human Rights

The final principle of social justice considered here, and arguably the most fundamental, is that of human rights. Stephen Fuller argues that human rights can be used as levers to accelerate our transition to a circular economy. The protection of the environment is key to human well-being and the effective enjoyment of human rights is dependent upon healthy ecosystems and biodiversity. Ghisellini & Ulgiati (2020) argued that cultural change is of paramount importance as it provides the ground for a new and more responsible vision of the relationship between humans and their environment, to better meet the imperatives of sustainable development. People value having respect shown for their rights and for their status within society and up-holding human rights is circular. The implementation of circularity for all materials in the economy must ensure that human rights are upheld for all people, with specific care for those made most vulnerable to harm.

4.4 Conditions and constraints for a just transition

A 'just transition' is the approach to decarbonising global economies in a way that is 'just' for people and the planet. This means transitioning to more environmentally sustainable economies in ways that minimise risks of harm to workers, communities and countries, while reducing inequality and creating decent work and quality jobs.

4.4.1 Conditions

According to the ILO Guidelines for a Just Transition towards Environmentally Sustainable Economies and Societies for all (year?), the following principles should guide the transition to environmentally sustainable economies and societies:

- Strong social consensus on the goal and pathways to sustainability is fundamental. Social dialogue has to be an integral part of the institutional framework for policymaking and implementation at all levels. Adequate, informed and ongoing consultation should take place with all relevant stakeholders.

- Policies must respect, promote and realize fundamental principles and rights at work.

- Policies and programmes need to take into account the strong gender dimension of many environmental challenges and opportunities. Specific gender policies to be considered in order to promote equitable outcomes.

- Coherent policies across the economic, environmental, social, education/training and labour portfolios need to provide an enabling environment for enterprises, workers, investors and consumers to embrace and drive the transition towards environmentally sustainable and inclusive economies and societies.

- These coherent policies also need to provide a just transition framework for all to promote the creation of more decent jobs, including as appropriate: anticipating impacts on employment, adequate and sustainable social protection for job losses and displacement, skills development and social dialogue, including the effective exercise of the right to organize and bargain collectively.

- There is no "one size fits all". Policies and programmes need to be designed in line with the specific conditions of countries, including their stage of development, economic sectors and types and sizes of enterprises.

4.4.2 Constraints

The main constraints to the adoption of a system based on circularity are:

- lack of guidelines for its implementation

- the not immediate feasibility for companies operating in certain economic sectors

- the perception of a lack of economic return in the short term against investments for change

- the lack of incentives (both for the producing company, its suppliers and collaborators, but also for the final customer)

- Not having full awareness of the social, economic and environmental benefits of such a change.

4.5 Conclusion

CE, which is based on environmental, economic and social dimensions and on each step of product creation, transformation and conversion by creating a closed loop economy, has greater chance of achieving sustainability. Despite the challenges that lie ahead, CE has the potential to foster a just transition, and to reduce existing tensions and struggles around resource conflicts and unequal distribution of resources, in particular by reducing the pollution burden on the poor and pre-empting negative impacts on employment. It remains unclear whether the current CE framework can promote the social well-being for this generation and generations to come. In addition, social dimension is an important area in the domains of circular economy and sustainable development. Therefore, it is critical to put considerations of equity and fairness at the heart of debates about the transition, and to understand the potential for just transitions in order to ensure that the processes are not disrupted and potential losers are supported, and that susceptible countries and vulnerable populations are not left behind. Therefore, all the stakeholders involving government departments and institution are increasingly striving to achieve a comprehensive understanding and valid measurement of social dimension to influence the overall proper implementation of CE to achieve sustainable development.

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Chapter 5. Energy and material costs of electric car-oriented Li-ion battery industry chains, within a perspective of social and environmental shared responsibility

Yanxin Liu, Sergio Ulgiati

Abstract

Demand for carbon emission reduction is promoting the development of the electric vehicle industry, within which Li-ion batteries play an important role as the main source of power storage. From the perspective of the Li-ion battery industry chain, the environmental impacts of 5 kinds of minerals and Li-ion batteries within the production process have been assessed by means of the Life Cycle Assessment (LCA) approach. The environmental impacts of 8 kinds of traditional and renewable energy sources were also analysed and compared. The extraction and use of crucial minerals as well as fossil energy resources bears huge environmental and social consequences, in that it affects large areas and large amounts of water for production processes and most often involves employees without sufficient care of their health problems and young age. From the perspective of global worldwide trade, this study puts forward the producers and users shared responsibility, emphasizing that importing countries also have the responsibility to bear the environmental impacts caused in producing countries, with special focus on mining and treating crucial minerals. The results show that: (i) nickel, cobalt and other rare metals have more significant impacts on carbon emission and ecotoxicity; (ii) Li-ion battery production has the most significant impact on freshwater and marine ecotoxicity; (iii) process energy use (mainly electricity) heavily affects the overall impacts, with hydroelectricity still showing the best environmental performance, in spite of its small availability and competition with other uses, followed by wind power, characterized by fast spreading worldwide, and photovoltaic, which still has to solve some toxicity problems in the production chain. Improvement are expected from several steps of the production process, starting from the extraction of minerals, the selection of less impacting minerals, the increased efficiency of produced batteries, and finally the end-of-life recycling of component minerals and metals. Based on the evaluation results, some policy suggestions are put forward from the perspectives of production, import and trade cooperation, shared responsibility of environmental and social consequences.

Keywords: Li-ion battery industry chain; Environmental impacts; Life cycle assessment; Circular Economy; Global shared responsibility

Although EV and Li-ion batteries are very promising for carbon emission reduction, they have large environmental and social impacts associated to extraction and production patterns. To promote a socially and environmentally sustainable low-carbon economy, it is necessary to first identify the key environmental impacts of the Li-ion battery industry and then promote increased awareness about the shared responsibility of producers and consumers, within a perspective of global worldwide trade.

5.1 Introduction

With the development of the global low-carbon economy, electric vehicles are expected to play an increasingly environmental role. According to Global EV Outlook, the number of electric vehicles in the world was less than 1.5 million in 2015, growing to about 16.5 million in 2022. In a seven-year period, EVs have increased by more than ten times, as a consequence of increased global people's and Governments´ attention to energy conservation and emissions reduction. Although electric vehicles are developing very quickly, they are still a minority, not void of challenges, compared to internal combustion engine cars. The number of internal combustion engine vehicles in the world in 2022 was about 1.446 billion, 87.6 times the number of presently running electric vehicles, with an unequal distribution of cars per capita in the different regions of the world as follows: North America 0.71 cars per capita, Europe 0.52, South America 0.22, Middle East 0.18, Asia-Pacific 0.14, Africa 0.05, Antarctica 0.05. Should electric vehicles replace the present number of combustion engine cars, the challenge is not only to replace the large number of presently running combustion engine cars in wealthy countries, but also to provide the large number of electric vehicles needed to bring the less developed countries to the same level of mobility per person as the industrialized and wealthy countries. The challenge therefore is to replace a large fraction of combustion engine vehicles by means of electricity powered mass transportation networks (railways, subways, buses) and a larger number of electric vehicles (at least for intensive users, such as taxi, health and emergency services, police, shared cars). For this to happen, a large number of components (batteries, electric engines, other components for electric engine control) is needed, which translates into mining or recycling an unbelievable amount of minerals and crucial metals. While railways and subways generally do not need to store electricity for their functioning, buses and cars are not connected to the electric grid and therefore require charge a battery to allow a sufficient number of kms. Such requirement translates into large weight of batteries (between 200 and 900 kg, depending on the car) and therefore requires the extraction of crucial minerals from worldwide mines. Extraction and refining of minerals and metals is not an easy task nor an environmentally friendly process. As a consequence, large areas and large amounts of process water (affecting the availability of drinking water) as well as large amounts of workforce (among which large fractions of child labor) are needed, so that "*The unprecedented increase in demand for the raw materials needed to produce the batteries to propel these vehicles poses serious human rights and environmental risks and begs the question how sustainable and fair a mobility transition based on the mass uptake of electric vehicles really is*." (González and de Haan, 2020). Special focus on children rights violation has been investigated by SOMO-Centre for Research on Multinational Corporations and Terres des Hommes, two Netherland Organizations, releasing an alarming report (Schipper and Cowan, 2018) concerning mica mining (including Lithium mica), where global responsibilities of several Governments and Companies and the urgent need to

address the problem emerge. “Mica” is the name given to a group of minerals that are physically and chemically similar. The mica group of minerals contains a total of 37 different types of mica. The main types of mica are: (i) muscovite or white mica (potassium mica); (ii) phlogopite or amber mica (magnesium mica); (iii) biotite or black mica (ferro-magnesium mica); and (iv) and lepidolite (lithium mica). Magnesium and lithium mica are used for two different types of electric car batteries. Li-ion batteries are the most advanced typology presently available in the global market and will be the main focus of the present research. However, other very interesting research activities are being developed, among which magnesium batteries, still at a laboratory stage, but claimed and expected to bear lower environmental impacts and economic costs. Just as an example, the AIT (Austrian Institute of Technology) and the ISTA (Institute of Science and Technology Austria have launched a research project about magnesium batteries in the hope to develop “another step towards the implementation of a sustainable, climate-friendly and efficient energy system in stationery and mobility sectors” (Emove360, 2023; Romio et al., 2023).
Among the main goals of this study are, therefore, the evaluation of the environmental consequences and associated social problems of the transition from combustion engine to electric vehicles powered by Li-ion batteries and the available improvement options. For this to be done, the environmental impacts of Lithium mining, Li-ion battery production and electricity production from different sources to provide large scale charging have been investigated through LCA in order to identify the main challenges and solutions.

5.2 The Li-ion batteries. Production and material demand

Li-ion batteries are considered the core components of electric vehicles. There are four main types of Li-ion batteries, namely LMO, NMC (111), NMC (811) and NCA. The code numbers 111 and 811 indicate approximate different proportions among main component metals, according to the different battery composition (Alejandro & Esther., 2020), as shown in **Figure 5.1**. LMO is the Lithium-Manganese-Oxide composition ($LiMn2O4$), of which 94% is Manganese and 6% is Lithium. NMC is Lithium-Nickel-Cobalt-Manganese Oxide ($LiNiCoMnO2$), where NMC (111) and NMC (811) are respectively the content of Cobalt, Nickel and Manganese: NMC (111) has 30% cobalt, 30% nickel, 29% manganese (and 11% lithium), while NMC (811) has 9% cobalt, 72% nickel, 8% manganese (and 11% lithium). NCA is Lithium Nickel Cobalt Aluminium Oxide ($LiNiCoAlO2$), with 2% aluminium, 14% cobalt, 73% nickel, and 11% lithium. Lithium is a crucial component of all four types of batteries, indicating that its role is, at present, irreplaceable. Battery manufacturing has become a priority and strategic goal in many world regions, especially China and European Union. The EU recently adopted the Battery Strategic Action Plan to accelerate the construction of a European battery value chain.

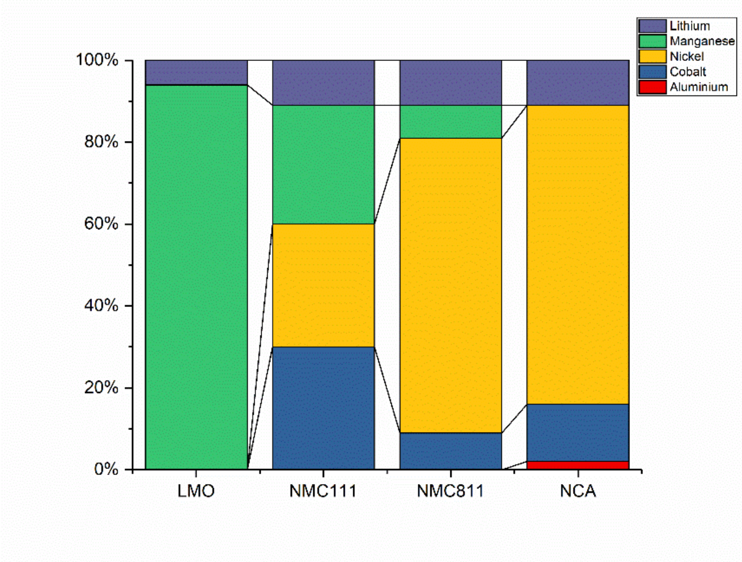

Figure 5.1 Composition of different Li-ion batteries (source: modified after Alejandro & Esther., 2020)

As demand for electric vehicles and batteries continues to rise, production for the minerals needed to produce them - lithium, cobalt, nickel, graphite, manganese - is also soaring. According to Statista (2022), the global lithium production in 2011 was only 0.34E+5 tons, while the global lithium production in 2021 was as high as 1.0E+5 tons, three times that of 2011. At the current rate of mining (assuming no electric car increase occurs), it could be expected that the world's lithium resources would be depleted in less than 220 years. Instead, if Lithium consumption increases due to the much larger demand for EVs (e.g., from the present 16.5 million vehicles up to very likely 10 times more in the near future), the present world Lithium resources would only last 22 years and additional Lithium discoveries may not be enough to meet future demand. This poses real challenges of replacement of metals and demand for smaller, more efficient and less impacting batteries and increased recycling. In addition to lithium, large amounts of cobalt, nickel and manganese, respectively 1.7E+5, 2.7E+6, 2.0E+7 tons, were mined globally in 2021. These minerals are, as well known, non-renewable resources, and most of them are rare metals. Long-term large-scale mining may not only cause the degradation of large environmental areas, but also irreversibly deplete mineral resources, which is not conducive to sustainable development. Due to resource distribution and economic development, minerals are unevenly exploited in the world. Taking Lithium reserves as an example, according to the United States Geological Survey (USGS, 2022), 22 million tons of lithium reserves are available worldwide, but they are not evenly distributed. About 9.2 million tons are estimated to be available in Chile, 5.7 million in Australia, 2.2 million in Argentina, 1.5 million in China, and a small number are distributed in Zimbabwe, Brazil, Portugal and other countries. Much larger estimates of Lithium availability have been made, just considering both discovered and undiscovered deposits worldwide - i.e. by definition a "best guess" of resources to become reserves. Of course, depending on depth and other physical factors, extraction prices vary significantly, which makes difficult to estimate their real availability to technological processes of battery production.

The "lithium triangle" countries of Argentina, Chile and Bolivia, which hold 75 percent of the world's lithium known reserves, jointly with the Democratic Republic of Congo (DRC) produce about two-thirds of the world's cobalt and already feel the economic pressure due to the so-called "battery boom". With the development of trade integration, the mineral reserves required for batteries are flowing over a large scale around the world, and the environmental

impact caused by mineral mining, transporting and processing as well as battery production is also transferred to a larger scale worldwide.
Of course, the possibility that larger amounts of resources are discovered and become available reserves (maybe at higher market cost) cannot be denied, but this would bear the consequence of increased environmental degradation in the mining locations, around the processing plants and all over the transport and storage chain. In a like manner, the limited availability of the above-mentioned minerals and metals may also push towards technological discoveries to allow the use of different metals, e.g., magnesium for use in a different kind of batteries competing with Lithium (AIT, 2023).

5.3 Environmental impacts of mineral resource exploitation for Li-ion battery production

As mentioned above, electric vehicle batteries contain a variety of mineral resources, and the environmental impacts of the mining process is also different. Taking lithium, cobalt, nickel, manganese and iron as examples, we used the life cycle assessment approach to analyse the impact of key raw minerals on water, air, soil and human toxicity over 18 environmental impact categories of the mining process. Of course, identifying these impacts is not just a technological achievement, but allows to understand the consequences on human health and ecosystem integrity. The data used in the mining process are from the Ecoinvent database, by means of the openLCA analysis tool. Table 1 shows the final results.

By comparing the impact categories of Table 1, with reference to a Functional Unit (FU) of 1 kg, it clearly appears, just as an example, that the carbon dioxide emissions of the five minerals (Global warming potential, GWP) are quite different. The largest amount of carbon dioxide emissions are associated to 1 kg of nickel and 1 kg of cobalt, with 13.9 kg and 10.4 kg of CO_2 eq emissions respectively, while iron mining released the least carbon emissions, only 0.006 kg CO_2 eq. In terms of contribution to "Human carcinogenic toxicity" and "Human non-carcinogenic toxicity", nickel mining has the most significant effect, releasing about 2.2 kg 1,4-DCB and 288.9 kg 1,4-DCB, respectively. The non-carcinogenic toxicity of nickel ore is really surprising, 18 times that of cobalt ore and 144 times that of lithium! In terms of "Terrestrial ecotoxicity", 1 kg of nickel mining can release 917.2 kg 1,4-DCB, suggesting that the impact of nickel mining on land is higher than on human health. The effect of iron ore and manganese ore is less than 1 kg 1,4-DCB. The results in **Table 5.1** suggest that nickel ore is the mineral with the largest environmental impact in electric vehicle batteries, which is particularly detrimental to the sustainable development of human and terrestrial health, followed by cobalt, lithium, iron and manganese. Considering the proportions of these metals in the composition of electric vehicles batteries (see Figure 1 above), it clearly appears that availability of minerals and their environmental impacts are crucial factors towards accurate use and recycling of exhaust batteries as well as towards design of less impacting devices based on different minerals and metals.

Table 5.1 LCA impacts of different metals used in the battery industrial chain (FU: 1 kg)

Impact category	Unit	Lithium	Iron	Manganese	Nickel	Cobalt
Fine particulate matter formation	kg PM2.5 eq	5.01E-03	1.73E-04	7.3E-05	4.28E-01	3.07E-02
Fossil resource scarcity	kg oil eq	6.03E-01	1.63E-03	4.54E-03	2.86E+00	2.45E+00

Freshwater ecotoxicity	kg 1,4-DCB	8.53E-02	7.05E-05	1.02E-03	8.49E+00	2.89E-01
Freshwater eutrophication	kg P eq	1.92E-03	8.06E-07	6.35E-06	4.67E-02	2.98E-03
Global warming	kg CO_2 eq	2.23E+00	6.01E-03	1.73E-02	1.39E+01	1.04E+01
Human carcinogenic toxicity	kg 1,4-DCB	3.03E-01	1.70E-04	1.98E-03	2.18E+00	3.12E-01
Human non-carcinogenic toxicity	kg 1,4-DCB	2.01E+00	1.67E-03	2.99E-02	2.89E+02	1.66E+01
Ionizing radiation	kBq Co-60 eq	2.12E-01	3.50E-04	1.09E-03	1.11E+00	1.14E+00
Land use	m^2a crop eq	9.48E-02	9.97E-05	1.62E-02	1.75E-01	5.39E-01
Marine ecotoxicity	kg 1,4-DCB	1.19E-01	1.00E-04	1.46E-03	1.22E+01	4.11E-01
Marine eutrophication	kg N eq	2.07E-03	2.22E-06	5.49E-06	3.96E-03	4.93E-03
Mineral resource scarcity	kg Cu eq	1.37E+00	2.86E-02	5.15E-02	3.78E+00	8.74E+00
Ozone formation, Human health	kg NO_x eq	8.83E-03	1.38E-04	2.69E-04	8.83E-02	9.25E-02
Ozone formation, Terrestrial ecosystems	kg NO_x eq	8.96E-03	1.41E-04	2.74E-04	8.98E-02	9.41E-02
Stratospheric ozone depletion	kg CFC11 eq	9.68E-07	2.47E-08	4.45E-08	1.72E-05	1.87E-05
Terrestrial acidification	kg SO_2 eq	1.43E-02	9.53E-05	2.07E-04	1.40E+00	8.67E-02
Terrestrial ecotoxicity	kg 1,4-DCB	9.78E+00	8.25E-03	1.56E-01	9.17E+02	3.19E+01
Water use	m^3	4.06E-02	2.64E-05	3.06E-04	1.57E-01	1.60E-01

Source: Ecoinvent 3.1 database (Ecoinvent 3.1, 2020) through OpenLCA software (GreenDelta, 2020)

Once the impacts of battery minerals are identified, it may be useful to “locate” these impacts starting from the countries where these minerals come from.

For example, the main 2021 producers of Lithium have been Australia (61,000 ton/yr), Chile (39,000 ton/yr), China (19,000 ton/yr) and Argentina (6,200 ton/yr), while the countries with the 2021 largest known (although not yet exploited) reserves are Bolivia (21Mt), Argentina (20 Mt), USA (12 Mt), Chile (11 Mt), Australia (7.9 Mt) and China (6.8 Mt) (Source: USGS, 2022).

In a like manner, the main 2021 Iron ore producers have been: Australia (900 Mt/yr), Brazil (380 Mt/yr), China (360 Mt/yr), India (240 Mt/yr), Russia (100 Mt/yr), Ukraine (81 Mt/yr), out of a total world production of 2,537 Mt/yr, while the main 2021 iron ore known reserves were in Australia (51 Gt), Brazil (34 Gt), Russia (25 Gt), China (20 Gt) Ukraine and Canada (both 6.5 Gt) (source: Canada, 2023).

Similar location of impacts and potential social and environmental risk related to the existence of large reserves can be performed for all the crucial minerals from Table 1 as well as others largely used in electronic and vehicle industry and may provide very useful suggestions for mining and trade policy making, within a circular economy and shared responsibility policy. Liu et al. (2021) investigated the 2020 worldwide trade of iron and steel, with special focus on mining, exports & imports, and steel making processes, identifying a significant transfer of embodied impacts (emissions, toxicity, land and water use) within the import/export dynamics, calling for urgent collaborative links to decrease the environmental damages in resource exporting countries and, to a different extent, in importing countries and suggesting compensation policies based on technology support and more appropriate economic return from importing to exporting countries.

5.4 Environmental impacts of electric vehicle battery production

Once impacts of crucial minerals mining have been assessed, it should not be disregarded that they are processed within the mining country and then further exported to more industrialized countries for processing to batteries (in this study, Li-ion batteries). This additional step is likely to generate further environmental and health impacts which add up to the mining phase. We therefore evaluated the whole environmental impacts of the production process of Li-ion batteries for electric vehicles, by using again the life cycle assessment method. The specific results are shown in Table 2. For each kg of rechargeable Li-ion battery produced, 6 kg of carbon dioxide, 95 kg 1,4-DCB contributing to carcinogenic and non-carcinogenic toxicity, and 4 kg 1,4-DCB contributing to marine toxicity, among other impacts. In fact, 0.075 m^2 of land and 0.18 m^3 of water are also consumed. Considering that the weight of Li-ion batteries for average electric vehicles is generally 300 kg and the annual production of electric vehicles in the world exceeds 10 million, it is easy to assess that the carbon emissions caused by the production of lithium batteries for electric vehicles in the world are about 1.8E10 kg CO_2 eq per year. In addition, it can be found from the normalized results in **Table 5.2** that Li-ion battery production has the biggest impact on freshwater ecotoxicity and seawater ecotoxicity. With the promotion of the global dual-carbon goal, the development of electric vehicles will become more and more rapid, and the production will be larger. If the production process will not be improved (in both design and recycling), being Li-ion batteries among the most important components of electric vehicles, their impact on the in the long-term will seriously affect human and ecosystem health.

Table 5.2 LCA impacts of Li-ion battery production (F.U.: 1 kg of Li-ion battery produced)

Impact category	**Reference unit**	**Characterized**	**Normalized**
Fine particulate matter formation	kg PM2.5 eq	2.54E-02	9.93E-04
Fossil resource scarcity	kg oil eq	1.62E+00	1.66E-03
Freshwater ecotoxicity	kg 1,4-DCB	2.78E+00	2.27E+00
Freshwater eutrophication	kg P eq	1.56E-02	2.40E-02
Global warming	kg CO2 eq	6.03E+00	7.55E-04
Human carcinogenic toxicity	kg 1,4-DCB	1.06E+00	3.82E-01
Human non-carcinogenic toxicity	kg 1,4-DCB	9.49E+01	6.37E-01
Ionizing radiation	kBq Co-60 eq	7.65E-01	1.59E-03
Land use	m2a crop eq	7.54E-02	1.22E-05
Marine ecotoxicity	kg 1,4-DCB	3.98E+00	3.85E+00
Marine eutrophication	kg N eq	3.49E-03	7.56E-04
Mineral resource scarcity	kg Cu eq	3.83E-01	3.19E-06
Ozone formation, Human health	kg NOx eq	1.97E-02	9.58E-04
Ozone formation, Terrestrial ecosystems	kg NOx eq	2.02E-02	1.14E-03
Stratospheric ozone depletion	kg CFC11 eq	4.16E-06	6.95E-05
Terrestrial acidification	kg SO2 eq	6.98E-02	1.70E-03

Terrestrial ecotoxicity	kg 1,4-DCB	2.95E+02	2.85E-01
Water consumption	m3	1.81E-01	6.78E-04

Source: Ecoinvent 3.1 database (Ecoinvent 3.1, 2020) through OpenLCA software (GreenDelta, 2020)

The take-home lesson is that in addition to the impacts associated to extraction of minerals in primary exporting countries, other impacts are generated in industrial countries, where batteries are produced and then sold to car producing companies. Considering that the weight of a battery to store electricity for an electric vehicle is between 300 and 1000 kg, the above unit LCA impacts should be multiplied by the weight of the battery in order to calculate the extent a Li-ion battery affects terrestrial and human health categories. Let´s just consider the 1.81E-01 m^3 of water per kg of battery: in the case of an average battery whose weight is about 500 kg, the total water demand for battery production (mining, transporting and processing) is around 500 kg x 1.81E-01 m^3/kg= 90 m^3, i.e. 90,000 kg of water, for a device which will more or less last 10 years. In a like manner, Global Warming impacts of a 500 kg battery would be around 3,000 kg CO_2 eq, Human Carcinogenic and Non-carcinogenic Toxicity would amount around 47,980 kg 1,4-DCB, and finally Terrestrial Ecotoxicity would be in the order of 147,500 kg 1,4-DCB, all of which to be divided by 10 in order to calculate the yearly impacts. Impacts will have to be multiplied by the expected number of electric vehicles in Europe and worldwide. As mentioned in the Introduction, the challenge to replace the presently existing 1.45 billion combustion engine cars worldwide compared to the about 20 million electric cars, is not as easy to address as it is most often shown in the media and literature. The available amounts of crucial minerals do not seem enough to spread electric vehicles worldwide, so that the near future of electric cars seems to be limited to the wealthy fraction of industrialized countries, leaving the large fraction of world population still without a car at all or still using combustion engine cars, due to both the insufficient amounts of resources and the environmental and social problems associated to resource mining, as mentioned in the previous sections. The potential increase of electric car number provides an alarming signal also concerning the impacts of batteries production for electric cars (let´s just think of the impacts from Table 2 expanded to hundreds of millions of potentially circulating electric vehicles), unless smaller and more efficient batteries are designed and less impacting minerals are used, in addition to increased recycling ability within a circular economy perspective (US DOE, 2023).

5.5 Environmental impacts of energy sources to support electric vehicles

The development of electric vehicles will also require that presently used fossil fuels are replaced by electricity to charge the batteries, worldwide. It does not deal with small amounts but instead very large fractions of present fossil fuel use. The needed electricity may be generated from fossil fuels, or nuclear and renewable sources. Large, energy-intensive plants will have to be built rapidly to meet the growing demand for electricity by household as well as to charge the increasing number of batteries for electric vehicles. In order to understand the environmental impacts of the electricity from different sources needed for electric cars, we may refer to a LCA study based on data from Ecoinvent database 3.1, published by one of the co-Authors of the present study in Ghisellini et al. (2023), partially shown in **Table 5.3**. The latter focuses on the environmental impact of generating 1 kWh of electricity from traditional and renewable energy sources, such as nuclear, wind, hydroelectric, geothermal, PV solar, natural gas, coal and oil. It is important to note that 1 kWh is able to support an average distance of 5 km in an electric car. None of the sources from **Table 5.3** is capable to offer a performance completely void of impacts. Mining and processing resources to build and operate an electric power plant generate unavoidable life cycle impacts as water and land use, energy and material resource consumption, emissions). Among these sources, hydroelectricity generates the least carbon emissions, only 7.49E-3 kg CO_2 eq, followed by nuclear energy, which releases 1.64E-2 kg CO_2 eq, while conventional coal and oil release the most carbon emissions, 1.14 kg CO_2 eq and 0.90 kg CO_2 eq respectively, as they require more fossil heat when generating electricity. Focusing on a different kind of impact, namely ionizing radiations, hydroelectricity and wind still have the smallest impacts, only 4.62E-4 kBq Co-60 eq and 1.87E-3 kBq Co-60 eq, while nuclear energy has the largest impact, about 1.19 kBq Co-60 eq. Moving to the human toxicity category, traditional coal shows the largest effect, about 2.6E-2 kg 1,4-DCB, while the smallest impact comes from hydro-power generation, only 7.70E-4 kg 1,4-DCB. In terms of water use (a resource depletion that cannot be disregarded due to its role in other aspects of human life and other species survival), the impact of these energy sources can be identified, with wind energy consuming the smallest amount of water resources, and geothermal and hydroelectricity the largest, in so affecting other, not negligible, water uses. In terms of Terrestrial acidification, the sulphur dioxide impact of traditional energy sources such as coal, oil and natural gas is generally very large, about 5.28E-3 kg SO_2 eq, 7.67E-3 kg SO_2 eq and 1.67E-3 kg SO_2 eq, respectively, while hydroelectricity and nuclear energy show the least impact, only 2.16E-5 kg SO_2 eq and 8.18E-5 kg SO_2 eq.

Although each electricity source has different impacts for the environment, yet wind energy and solar energy seem to be a real alternative to traditional fossil fuels. They are renewable, large-scale applicable, and their cost is acceptable at present. In addition, wind energy has little impact on water resources consumption and negligible Ionizing radiation, while solar energy has little impact on atmospheric ozone and land use. In order to maximize sustainable development, it is necessary to use a combination of energy sources to ensure that the environmental impact of different dimensions is minimized. Anyway, even if these renewable sources are quickly developing, they may not be a sufficient energy support to a fast development and increase of electric car number, so that charging ability may become another limiting factor to the spread of electric cars worldwide to a large extent.

Table 5.3 LCA impacts per 1 kWh of the production of electricity from different sources (from Ghisellini et al., 2023)

Impact category	**Nuclear**	**Nat. gas**	**Coal**	**Oil**	**PV**	**Deep heat (*)**	**Wind**	**Hydro-power**
Fine particulate matter (kg PM2.5 eq)	4.83E-5	5.61E-4	1.81E-3	2.37E-3	1.59E-4	1,57E-4	5.53E-5	1.13E-5
Fossil resource scarcity (kg oil eq)	4.09E-3	2.60E-1	2.26E-1	2.81E-1	1.67E-2	1.76E-2	6.45E-3	1.19E-3
Freshwater ecotoxicity (kg 1,4-DCB)	1.18E-3	1.93E-3	1.29E-2	1.80E-3	1.75E-2	2.42E-3	1.95E-2	1.22E-3
Freshwater eutrophic. (kg P eq)	6.18E-6	2.86E-5	4.16E-4	1.56E-5	5.48E-5	1.43E-5	1.55E-5	1.43E-6

Global warming (kg CO_2 eq)	1.64E-2	6.84E-1	1.14E+0	9.02E-1	6.57E-2	6.27E-2	2.58E-2	7.49E-3
Human carcinogenic toxicity (kg 1,4-DCB)	2.24E-3	3.94E-3	2.60E-2	4.36E-3	6.06E-3	7.59E-3	8.47E-3	7.70E-4
Human non-carcinog. toxicity (kg 1,4-DCB)	3.14E-2	5.20E-2	3.91E-1	6.32E-2	2.47E-1	5.68E-2	8.63E-2	6.47E-3
Ionizing radiation (kBq Co-60 eq)	1.19E+0	1.23E-2	8.25E-3	1.44E-2	1.02E-2	2.76E-3	1.87E-3	4.62E-4
Land use (m^2a crop eq)	1.49E-4	2.68E-4	5.79E-3	4.26E-4	3.90E-4	2.69E-4	9.12E-4	6.04E-5
Marine ecotoxicity (kg 1,4-DCB)	1.74E-3	2.86E-3	1.80E-2	4.82E-3	2.30E-2	3.23E-3	2.39E-2	1.50E-3
Marine eutrophication (kg N eq)	8.28E-6	1.76E-5	4.45E-5	5.00E-5	5.34E-5	6.89E-6	1.06E-5	1.80E-6
Mineral resource scarcity (kg Cu eq)	8.94E-4	4.44E-4	3.75E-4	4.02E-4	1.37E-3	1.62E-3	1.48E-3	2.18E-4
O_3, Human health (kg NO_x eq) (#)	5.11E-5	1.03E-3	2.20E-3	2.86E-3	1.74E-4	4.48E-4	7.58E-5	2.04E-5
O_3, Ecosystems health (kg NO_x eq) (#)	5.21E-5	1.08E-3	2.20E-3	2.90E-3	1.81E-4	4.57E-4	7.88E-5	2.08E-5
Stratospheric ozone depletion (kg CFC11 eq)	4.17E-8	3.26E-7	2.77E-7	6.21E-7	3.63E-8	7.05E-8	1.08E-8	4.11E-9
Terrestrial acidification (kg SO_2 eq)	8.18E-5	1.67E-3	5.28E-3	7.67E-3	4.04E-4	3.09E-4	1.19E-4	2.16E-5
Terrestrial ecotoxicity (kg 1,4-DCB)	3.28E-1	1.13E-1	3.25E-1	3.13E+0	1.43E+0	1.35E-1	2.44E-1	2.08E-2
Water use (m^3)	3.15E-3	1.05E-3	1.88E-3	2.30E-3	1.84E-3	1.32E-2	3.29E-4	2.93E-2

(*) Geothermal energy; (#) Impacts generated on human and ecosystems health by generation of tropospheric ozone (O_3)

5.6 Shared responsibility for environmental costs of electric car-oriented Li-ion battery industry chain

It clearly appears from the previous sections that mineral mining, battery production and power plants for charging are three unavoidable phases of the transition from conventional combustion engine vehicles to electric vehicles, and that these phases bear significant environmental, technological and social consequences in primary minerals exporting countries as well as in battery and electricity production countries within an international minerals and fuels trade framework. Each phase and related impacts require very carefully management and innovative policies for global mobility design, efficient technologies, just workforce use to prevent human rights disregarding (especially child work in mining countries and impacts on human health, water depletion and land demand). Therefore, the likely unavoidable transition to electric vehicles is not an easy task, but instead a challenge that requires the aware convergence of environmental and technology researchers, industry operators (for both production and recycling phases), mobility and urban planners (for appropriate implementation of mass transportation networks and individual mobility tools) and economic policy makers.

With the development of the global low-carbon economy, the demand for electric vehicles and lithium-ion batteries is increasing rapidly. But because of factors such as resource endowments, social development and technology, many countries need to trade to get the products they need. At the same time, with the deepening of global trade integration, the scale of international trade is also expanding (Liu et al., 2020). At present, global trade is largely determined by the market price of products. The impacts that the exporting countries face in minerals mining and manufacturing are most often disregarded by the importing countries, which generally only focus on the price and quality of the products. Most often, countries that mine and export minerals or import and process them into Li-ion batteries and other electronic devices for market export have also come under international criticism for the pollution they produce (**Tables 5.1** to **5.3**). Further, mining producing countries export resources and goods abroad to support internal and external economies and suffer from large environmental impacts, but the economic return they receive from trade is barely enough to compensate for the environmental impacts they must suffer. From the perspective of demand, the environmental impact should not only strictly associated to the producing countries: also, the countries which import the products should bear some responsibility. Selling goods at the lowest possible price determined by international competition is not the best way to promote or reward cleaner production efforts. Very few (if not none) importing countries choose trading partners based on their environmental performance in order to encourage exporting countries to adopt environmentally sound methods of producing goods. Trade must be a win-win effort for shared well-being and sustainable development, and it may be time for the international community to "share their environmental responsibility." For the importing country, the cost of import benefits is lower in the absence of social responsibility for pollution problems. Sharing responsibility may mean additional costs for importing countries, but it will also help producing countries develop better products with less impacts. Given the complexity of market prices, importing countries can be held liable in other ways besides paying additional costs. For example, (i) working with producing countries to develop more rational joint pollution management agreements and terms of trade; (ii) or sharing advanced technology and expertise with exporting countries. When it comes, for example, to the global steel trade, it is critical that governments and businesses recognize that the environmental burden should not be borne by just one player in the trading system (exporters), but other trading partners (importers) as well. This means that producing countries should be committed to improvement and exporting countries should also be aware that a large part of the impacts is due to their demand for low-cost primary or refined commodities and should therefore lead to joint efforts to prevent environmental impacts by promoting investment for better extraction and processing.

5.7 Conclusions

The rapid development of the global electric vehicle industry has made Li-ion batteries a crucial device as a power source (and storage) for electric vehicles. However, lithium batteries and electric vehicles need large amounts of minerals, energy and water in the production process, while releasing carbon and toxic emissions. Given that trade demand is also one of the main reasons for production, importing countries also have a responsibility to help improve the battery technology and mitigate environmental impacts. Therefore, this entails nonnegligible policy implications.

In producing countries, first of all, more recycling is necessary. Considering the stock of mineral resources is limited compared to the worldwide demand, in order to promote circular economy and sustainable development, producing countries should maximize technologies that minimize the use of resources and that promote the implementation of recycling to new production. Through the recovery of Li-ion battery and electric vehicle, the reuse of resources is strengthened. Secondly, optimizing power sources is crucial. There are many types of energy sources to provide electricity, and some of them (PV solar, wind, deep heat, etc.) have lower impacts on the environment than others (fossil, nuclear). Appropriate energy mixes depending on each country´s availability and technological factors, may help minimize environmental impact of electricity for charging, i.e. of the transition from fossil fuels for combustion engines to electricity for electric car batteries. Third, improve production efficiency. Increasing production capacity through technological innovation and other means may help improve the utilization of mineral resources, thereby reducing the high demand for raw materials and energy.

In wealthy countries, the present large number of circulating cars as well as electric cars can be reduced through car sharing and mobility networks such as subways and other forms of electrified public transport. Providing the same service by using fewer cars will require fewer batteries, thereby reducing mineral and energy demand and its associated negative environmental impacts such as carbon emissions and mining-related pollution. This would leave the available electric cars to more intensive uses, such as taxi, security and health services. Secondly, long-distance commuting demand between living and working places should be reduced, in order to decrease the need for car mobility by improving urban planning. It should be clear to mobility policy makers that increasing traffic will make mobility harder, no matter cars are combustion or electric engines powered.

For trading partners, strengthening shared environmentally responsibility for global trade and resource availability is urgently needed. While some countries have applied the "polluter pays principle" to greenhouse gas emissions and responsible waste disposal, the United Nations Environment Program, and other international decision makers can still push countries that import large amounts of Li-ion batteries (as well as other electronic devices not dealt with in this study) and related minerals to pay a price that includes the cost of pollution. The related tax income could be used to help producing countries invest in cleaner production technologies and improve recycling, thereby protecting local and global ecosystems. Incentives can also be helpful as an alternative to taxes, perhaps easier to implement within market mechanisms. Importing countries can also help their trading partners decrease their environmental impact by exchanging technology and developing sensible joint pollution management agreements.

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Chapter 6. Stakeholders' engagement and decision-making process: methodologies and techniques to assess strategies towards a Just Circular Economy

Gabriella Maselli, Antonio Nesticò

Abstract

The transition to a CE is now a necessary step to address pressing environmental challenges such as climate change, resource depletion and biodiversity loss. Consequently, it is of growing interest to characterise decision support methods that can guide analysts towards more sustainable investment choices. However, despite increasing research efforts, the literature on economic-environmental assessments and decision-making processes related to CE is still limited and fragmented. Current visions of the circular economy are narrowly focused on economics and technology, while there is an apparent lack of reflection on political and socio-cultural dimensions as well as justice issues (social, environmental and gender). In this context, stakeholders' involvement, which to date is passive and unstructured, becomes a key factor for the transition to a socially conscious circular economy. Therefore, this contribution intends to address the issue of the still marginal stakeholder involvement at all stages of the decision-making process.

This paper has a twofold aim. First, we provide a brief overview of existing research on methods and techniques for the economic, environmental, and multi-criteria evaluation of strategies for the transition to the CE, highlighting their limitations and strengths. Secondly, we outline a methodological approach that can support decision-makers: (i) in assessing the economic and socio-environmental performance of a single CE strategy; (ii) in selecting the most sustainable CE alternatives, considering the targets of the different stakeholder groups involved. In other terms, we propose a methodological framework, structured in different steps, to identify the stakeholders and apply integrated indicators to evaluate the CE strategies and their impacts (environmental, economic, and social). This methodological approach not only represents a valuable tool for policy makers, but also becomes necessary to promote shared decision-making processes within the CE transition.

Keywords: CE strategy; stakeholders' engagement; economic evaluation; socio-environmental assessment; multicriteria decision making.

> The approach defined in this contribution represents a potential support to the decision-making process, making it possible to consider the different perspectives of the stakeholders involved and to integrate the multiple dimensions of CE.

6.1 Introduction

In recent decades, phenomena such as urbanisation, globalisation and consumerism are more and more leading to the loss of biodiversity, increasing greenhouse gas emissions and the depletion of natural resources. In this regard, it is estimated that by 2050 natural resource consumption and waste generation could double compared to today (IPCC, 2022; Kulakovskaya et., 2022). In the latest International Energy Agency (IEA) report (2022), global electricity demand is expected to grow by 2.4 % per year for the rest of this decade, reaching more than 30,600 TWh by 2030. Furthermore, in 2021, the rapid post-pandemic economic recovery not only led to an additional demand for energy but, due to adverse energy market conditions, the use of coal increased at the expense of renewables (IEA, 2021). This resulted in an overall growth of more than 2 Gt in greenhouse gases compared to 2020 levels, offsetting, among other things, the decrease in emissions of about 1.9 Gt recorded during the pandemic. In sum, global CO2 from energy production and industrial processes reached 36 Gt, thus adding 6% to the 2020 level (IEA, 2021; Bruno et al., 2023).

Actions and strategies anchored in the CE paradigm represent a promising way to pursue the Sustainable Development Goals (SDGs) defined in the Paris Agreement (United Nations, 2015) and to address the environmental and climatic challenges (Kirchherr et al., 2017; Kulakovskaya et., 2022). Scholars, entrepreneurs, and decision-makers agree on the need to move from a linear economy, based on production-consumption-waste patterns, to a circular economy, based on production-consumption-reuse patterns (Ellen McArthur Foundation, 2013; Garcia-Bernabeu et al., 2020).

The concept of CE has been developed by scholars in environmental economics, functional service economics and industrial ecology since the 1960s (Boulding, 1966; Daly, 1996; Graedel, 1996; Lifset and Graedel, 2002), only attracting the interest of policy makers and industry at the beginning of the 21st century. To this day, CE remains a difficult concept to define, having been jointly developed in various fields, such as engineering, economics, or politics, and on various levels: micro, meso and macro (Mazur-Wierzbicka, 2021). For this reason, multiple definitions of the CE have been proposed over the years, in some cases even conflicting. Suffice it to say that it has been interpreted both as a strategy, and as a new economic paradigm (Haas et al., 2015; Bocken et al., 2016; Calisto Friant et al., 2020). Some authors have defined it as an industrial model or an industrial system (Yuan et al., 2006; Hobson and Lynch, 2016). According to others, however, it can be understood as a new business and development model (Ghisellini et al., 2020) or an economic system (Liu, 2012; Murray et al., 2017).

Among the most interesting interpretations is that of the MacArthur Foundation (2012), according to which: "A circular economy is an industrial system that is restorative or regenerative by intention and by project. It replaces the concept of "end of life" with restoration, moving towards the use of renewable energy, eliminating the use of toxic chemicals, which compromise reuse, and aims at the elimination of waste through the best design of materials, products, systems and, internally, business models". According to Ghisellini et al. (2016), the CE concept emerges as an alternative system aiming to decouple economic growth from resource constraints. Reike et al. (2018) point out that a CE action requires an absolute reduction of resource inputs as well as a balance between the different dimensions of sustainability. Again, Bocken et al. (2017) highlight that CE strategies aim to maximise the utility of products, components, and materials by extending their useful life through reuse, recycling and closing resource cycles. It is precisely the importance of 'closing of resource cycles' that has led to an evolution of the principles on which CE is based. In fact, initially the CE was anchored exclusively to the 3Rs principle: Reduce, Reuse and Recycle; then, it moved to the broader 4Rs principle, which also adds the concept of 'Recover'; finally, the more comprehensive 6Rs framework was outlined, which also includes 'Redesign' and 'Remanufacturing' and signals the transition from Circular Economy to Helical Economy. This 6R principle can offer a 'closed' product life cycle system, which becomes the basis for more sustainable production (Jawahir and Bradley, 2016; Yang et al., 2017; Ghisellini and Ulgiati, 2020).

It is evident that CE is becoming an important field of academic research and is attracting increasing interest from scholars, decision-makers and even companies producing goods and services (Ellen MacArthur Foundation, 2013; Geissdoerfer et al., 2017). This also applies to national governments. It suffices to mention, among others, the European regulations on waste management and recycling of end-of-life vehicles (Council of the European Communities 1993; 1999), the Sixth Environment Action Programme (European Parliament and of the Council, 2002), the Thematic Strategy on the Sustainable Use of Natural Resources (Commission of the European Communities, 2005), or Roadmap to a Resource Efficient Europe (European Commission, 2011). In this context, 'Closing the loop - an EU Action Plan for the Circular Economy' is the most important document of the Commission of European Communities (2015): the aim is to define actions and strategies to be implemented by the Member States to contribute to the transition from a linear to a CE model.

Policymakers, academics, and business community recognize the definition and implementation of programs and strategies aimed at the transition towards the CE as a priority and urgent action. It therefore becomes essential to evaluate the environmental, economic, and social performance of circularity alternatives. However, most of the current methods and tools for the evaluation of CE strategies focus only on one of the dimensions of sustainability, on a limited number of indicators and the perspectives of the stakeholders involved are analysed individually. In summary, the literature still lacks a quantitative and integrated methodological approach capable of considering the perspectives of the different groups of stakeholders and which helps decision makers to select the most sustainable alternatives that allow a just transition to the CE. This contribution therefore proposes a methodological framework, structured in several steps, useful for: (i) identify stakeholders and apply integrated indicators to assess CE strategies and their impacts (environmental, economic and social); (ii) promote shared decision-making processes within the transition to the circular economy.

6.2 Circular Economy: Critical issues and challenges

The concept of CE and the principles on which it is based are not without criticism and challenges, despite its growing acceptance by academics, politicians and business leaders. In this regard, the lack of consideration of socio-technical issues is one of the main criticisms levelled at CE, as highlighted by the H2020 project 'JUST2CE' (A JUst Transition TO the CE).

In fact, the current visions of the CE are predominantly focused on economics and technology, with a clear lack of reflection on the political and socio-cultural dimensions, as well as the justice issues (social, environmental and gender) that the transition to the CE would entail (Zwiers et al., 2020). The shift from a linear to a CE represents such a radical change that it implies a major transformation of current production and consumption patterns, which in turn will have a significant impact on the economy, the environment and society. Therefore, CE will always have to be addressed in all its complexity, as a political and social concept. Although some definitions of CE emphasise its social dimensions, recent studies show that the social dimensions (labour, gender, justice) have been consistently neglected (Hobson and Lynch, 2016; Mies and Gold, 2021).

As pointed out in the introductory section, another issue of great importance but still insufficiently investigated is that of stakeholder involvement. This theme represents a key element of a socially aware CE, because stakeholders actively contribute to the achievement of societal welfare. They are not passive actors as in the case of neoclassical market economics, where they act in a context of limited rationality and where the welfare of society is left exclusively to the 'invisible hand' of the market.

According to some authors, the lack of stakeholder involvement represents one of the major barriers to the implementation of CE (Farooque et al., 2019; Vermunt et al., 2019).

Stakeholder theory has often been applied in the sustainability literature and has been recognized as crucial to understanding how to implement CE into an organization's practices and supply chain (Shah and Bookbinder, 2022). However, research to date mainly focuses on specific elements of stakeholder engagement, while only a limited number of studies have considered stakeholder engagement from a global perspective for CE implementation (Tapaninaho and Heikkinen, 2022). In this regard, some scholars call for a better understanding of stakeholder engagement in the CE context and how it can be established to facilitate the transition from linear to circular resource flows (Allen et al., 2021). This paper aims to fill these research gaps by exploring how the role of stakeholders is crucial in the decision-making process regarding actions and strategies aimed at CE (Fobbe and Hilletofth, 2022).

Although several issues have already been explored from different perspectives, a comprehensive framework of methodologies and techniques for the economic-environmental assessment of circular systems is still lacking (Sassanelli et al., 2019; dos Santos Gonçalves and Campos, 2022). According to some authors, analysis methods should fully evaluate CE strategies, including environmental, social, and economic performance. According to others, only a few studies refer to multidimensional analyses, as most evaluations of CE strategies focus on the environmental dimension alone and often not even all impact categories are included (Ghisellini et al., 2018; Hossain et al., 2020). Instead, to adequately assess circularity, it is necessary to define a quantitative and integrated methodological approach able to address the needs of all involved stakeholders. In this regard, research has shown how stakeholder engagement is a critical factor in the implementation of sustainability principles, but there is limited knowledge on stakeholder engagement practices in a CE context (Fobbe and Hilletofth, 2023).

6.3 Literarature Review

Ensuring CE principles is becoming a fundamental requirement to be achieved right from the design phase of new products. It follows that the evaluation of design solutions is also changing significantly in this direction, as it is becoming increasingly essential to consider new aspects in the relevant analyses (Spreafico, 2022).

In the literature, several authors have identified and classified strategies, methods and tools useful for the design of products to facilitate the transition to CE. These studies have highlighted the number and heterogeneity of possible supporting approaches and their evaluation criteria, which can often also differ significantly depending on the application field (Bocken et al., 2016; Mestre and Cooper, 2017; Spreafico, 2022). According to Sassanelli et al. (2019), many of the current methods and tools for the evaluation of CE strategies focus on only one of the dimensions of sustainability, on a single or a limited number of indicators, individually analysing the perspectives of the sthekholders involved. In this respect, products and strategies of CE are mainly evaluated through:

(i) environmental assessments conducted mainly by implementing methods such as LCA, material flow analysis, emergy/exergy analysis, input-output analysis, system dynamics (Walzberg et al., 2021);

(ii) economic analyses, aimed at estimating the costs and benefits of intervention strategies, according to a Life Cycle Thinking (LCT) approach (Fregonara and Barreca, 2022);

(iii) multicriteria decision analysis, employed for measuring different CE aspects at different levels (micro, meso, and macro) (dos Santos Gonçalves and Campos, 2022).

In order to provide guidelines to stakeholders such as scholars, policy-makers, entrepreneurs, and non-profits organisations, we provide a brief overview of existing research on methods and techniques for economic, environmental and multi-criteria evaluation of strategies for the transition to the CE.

6.3.1 Environmental analysis

In recent decades, there has been a growing interest in the development of methods for assessing the environmental performance of products, services, processes, and intervention strategies. The most widely used methods in the literature are: LCA, Environmentally Extended Input-Output Analysis (EEIOA), Material Flow Analysis (MFA), emergy/exergy analysis.

LCA is a standardised method (ISO, 2006a,b) that aims to quantify the environmental impacts of products and services from raw material extraction to end-of-life. An LCA study is based on four steps: (i) definition of the objectives and scope, in which the FU for which the environmental impact is measured and the boundaries of the system under analysis are identified; (ii) inventory, which results in the quantification of input and output flow data for each stage of the product life cycle; (iii) impact assessment, in which the information from the previous step is classified and aggregated into the different environmental impact categories; (iv) interpretation of the results and definition of recommendations for the containment of environmental impacts (ISO, 2006a,b). It is a widely recommended method for assessing, among others, the environmental performance of services (Chen and Hiang, 2019), industrial products and systems (Rosa et al., 2019; Gribaudo et al., 2020), and building and construction projects (Dong and Ng, 2015; Rosado et al., 2019). A strand of recent literature has identified four main limitations in the application of LCA: 1) difficulties in comparability, 2) lack of sufficient and qualified data, 3) issues scaling up the data, and 4) uncertainties and communication of uncertainty (Moni et al., 2019). In addition, the standardised LCA (ISO, 2006 a,b) is typically implemented with reference to a static system. Therefore, all impacts are evaluated (and averaged) over space and time, which limits their use in the case of EC strategies that often involve complex and evolving systems (Walzberg et al., 2021). Finally, since LCA is limited to the assessment of environmental externalities, other methods have been developed to analyse the economic and social impacts of a product's life cycle, respectively life cycle costing (LCC) and social life cycle assessment (S-LCA) (Fauzi et al., 2019).

EEIOA quantifies the environmental impacts related directly or indirectly to a product or service, but not always including the use or end-of-life phases (Jeswani et al., 2010). While LCA provides a detailed analysis of each process involved in the life cycle or in a product system, EEIOA brings together national inventories to describe the interdependence between economic sectors (Miller and Blair, 2009).

MFA consists of “a systematic assessment of the flows and stocks of materials within a system defined in space and time” (Elia et al., 2017). The MFA aims to understand the material processes of a system to make better decisions regarding, for instance, waste management. To implement MFA, the system boundaries must first be defined, then all relevant processes and flows in the system must be modelled. In MFA, processes are generally more aggregated than in LCA and EEIOA. Compared to LCA, MFA does not focus on environmental impacts and usually focuses on a small set of materials rather than all related materials and energy flows of a product (Walzberg et al., 2021).
An alternative approach to those mentioned above is that of emergy/exergy analysis. The concept of Emergy was developed in the 1980s by the American ecologist H.T. Odum (Odum 1986, 1996) as the total available energy (exergy) of one kind that was required (used up) directly or indirectly in the work of making a product or a service (Brown and Ulgiati 2016 a,b). Emergy can thus aggregate flows of energy and matter of different kinds into a common unit, using conversion factors called Unit Emergy Values (UEV). They express the amount of equivalent solar energy invested in the production of a unit quantity of a supplied resource and are usually measured in solar emjoules per joule. Marvuglia et al. (2018) argue that although emergy-based indicators probably fail to account for all the elements needed to assess EC systems as a whole, they do allow for resources that would otherwise be ignored using material balance approaches.

6.3.2 Economic evaluations

Estimating costs and benefits of CE strategies is crucial to support decision-makers and stakeholders in choosing between investment initiatives.
In this context, remains the main tool to identify and assess the impacts of a project on social welfare, comparing positive effects (benefits) with negative ones (costs).
The CBA takes the form of: forecasting the costs and benefits that the investment is able to generate over the period of analysis; subsequently discounting the cash flows; then, estimating the synthetic profitability indicators, namely the Net Present Value (NPV), the Internal Rate of Return (IRR), the Benefit/Cost Ratio, the Payback Period.
However, two critical issues related to this evaluation approach should be noted: (i) CBA requires the transformation of investment cash flows (difference between monetary income and expenditure) into monetary terms to make them comparable and to summarise the result through a single indicator. This is a crucial step when it comes to assessing environmental and social externalities of the project; (ii) the choice of the Social Discount Rate (SDR), which represents the rate at which the community is willing to exchange present consumption for future consumption. The choice of SDR becomes particularly critical when considering projects aimed at achieving CE whose benefits are only evident in the long run. This is because conventional discounting uses constant discount rates over time, leading to an excessive decrease in the present value of the project’s costs and benefits for future generations (Nesticò et al., 2023).
Regarding question (i), specific approaches are needed to estimate environmental externalities. The latter, in fact, can be estimated using Willingness-To-Pay (WTP) approaches, which measure the maximum value that people are willing to pay for a given good, service or effect that is considered desirable. Several techniques exist to estimate the WTP: the revealed preference method, the stated preference method and the benefit transfer method.

The choice of method depends on the nature of the benefit to be estimated and the availability of data (European Commission, 2014).
To overcome problem (ii), on the other hand, some scholars propose using Declining Discount Rate (DDR) or time-declining discount rate instead of constants, to assign progressively increasing importance to long-term implications (Cropper et al., 2014). According to other scholars, discounting has a critical impact on sustainability. Therefore, environmental consequences should be discounted differently from economic ones (Gollier, 2011; Almansa and Martínez-Paz, 2011). This means that a dual discount rate should be used in CBAs for projects with significant environmental impacts: one discount rate for strictly financial cash flows; another lower value rate for the valuation of environmental externalities (Gollier, 2011; Nesticò and Maselli, 2020).
Although the use of CBA is fundamental for analysing the economic feasibility of CE strategies, the transition from linear to CE occurs with the inclusion of life-cycle approaches in the evaluation discipline. This means that cost estimation is also extended to the stages preceding and following the design and construction phases of the work (Fregonara and Barreca, 2022). It is in this context that the transition is made from the concept of construction cost, as conceived by classical Property Valuation, to that of Global or Life Cycle Cost (EN 15459-1:2017), in accordance with international energy policy regulations (Directive 2018/844/EU – EPBD). Il Life Cycle Cost sums the present value of all costs over the life cycle, including residual values such as negative costs. According to the Royal Institute of Chartered Surveyors (RICS, 2016), a distinction should be made between Life Cycle Cost (LCC) and Whole Life Cycle Cost (WLCC): the former focuses only on construction, maintenance, operation, occupancy and disposal of the asset; whereas WLCC encompasses a broader economic matrix, including not only construction and other life cycle costs, but also: (a) 'non-construction costs', such as site acquisition, lease or sale costs, procurement costs and the cost of financing; (ii) 'income' from the built asset; (iii) external costs or externalities, including impacts on the environment, to be assessed through LCA and the social impacts of the built asset. Therefore, the WLCC can be understood as a methodology for assessing the economic effects of sustainability, which allows for more comprehensive decision making based on sustainable evaluation rather than initial costs alone (RICS, 2022). Thus, according to a widely accepted classification, three types of LCC can be distinguished: (a) financial (fLCC) or conventional, which considers the internal costs related to a specific product and incurred by a specific actor and which results in the estimation of the Global Cost; (b) environmental (eLCC), which also takes into account monetised environmental externalities and which is embodied in the estimation of the WLCC; (d) social (sLCC), which can further expand the boundaries of the analysis by including direct and indirect costs incurred by society (Jansen et al., 2020).

6.3.3 Multicriteria decision analysis

Multi-criteria Decision Making (MCDM) methods allow structuring and solving complex problems that involve multiple quantitative and qualitative criteria often in conflict with one another (Nesticò et al., 2022). They are decision-support tools, based on five elements: (i) the overall goal to be achieved; (ii) the decision maker or group of decision makers expressing their preferences; (iii) evaluation criteria against which the alternatives are assessed; (iv) the alternatives under evaluation, among which the best alternative is to be identified; (v) scores expressing the value of the alternatives with respect to each criterion. The MCDMs most frequently used in the literature include: the Analytic Hierarchy Process (AHP); the Elimination Et Choix Traduisant la Realité (ELECTRE); the Tecnique for Order Preference by Similarity to Ideal Solution (TOPSIS); the Compromise Ranking Method

(VIKOR, from Serbian "Viekriterijumsko Kompromisno Rangiranje"). The choice of one method over another is mainly conditioned by the specificity of the case study, the objective to be pursued, and the availability of useful data to carry out the processing, all factors that may guide the evaluator differently from time to time in choosing the optimal approach (Nesticò et al., 2022). Although the various MCDM methods are based on different mathematical formulations, four main common steps can be distinguished: (a) definition of one or more decision matrices; (b) normalization of one or more decision matrices; (c) assignment of "weights"; (d) calculation of alternative ranking.

MCDM methods, therefore, allow decision-makers to identify trade-off solutions by considering different criteria, types of both quantitative and qualitative information, interest of stakeholders, relative significance of criteria, and decision-maker preference. For this reason, they are increasingly used in the literature to evaluate the performance of circularity strategies. The literature shows that MCDM methods have been employed to evaluate various aspects related to CE, including: waste management, value recovery, R's approach, energy efficiency, social aspects, bioeconomy, efficient use of resources, product design, and product life cycle (dos Santos Gonçalves and Campos, 2022).

Furthermore, studies in the field do not indicate which MCDM method is best to use in the context of CE, however, techniques such as TOPSIS, AHP and PROMETHEE are the most widely used. Moreover, the joint use of different multi-criteria techniques is also an increasingly tried-and-tested avenue as it yields interesting results in the evaluation of CE strategies.

Finally, a crucial step in the implementation of MCDM methods concerns the choice of sustainability indicators and the assignment of criteria weights. The choice of indicators is crucial to more or less correctly evaluate the dimensions of sustainability. However, it emerges from the literature that there is still little attention to the social dimension and that the existing approaches based upon CE metrics are not adequate for the structural change required for a just transition (Calzolari et al., 2022).

Furthermore, the estimation of criterion weights is significantly influenced by the preferences of decision-makers and thus represents a subjective step that may influence the choice of the preferred alternative. Nevertheless, CE indicators integrate well with multi-criteria techniques when the objective is to establish a balance between environmental, social and economic dimensions (Petrović et al., 2019).

6.4 Methodological approach and stakeholders

Starting from the gaps and strengths that emerged for each analysis - environmental, economic and multi-criteria - we define a methodological approach useful to evaluate the performance of a strategy or to select among several EC actions the most sustainable one.

If the goal is to evaluate a single CE strategy, we refer to the following logical-operational steps:

a.1) Identification of the stakeholders involved. The transition to a circular economy requires the involvement and collaboration of all stakeholders in society, from the organisations that produce goods and services to the consumers who buy them, from local, regional, and national governments to the community at large. Identifying stakeholders is crucial to analysing the economic, environmental, and social effects generated by the investment initiative.

a.2) Assessment of economic feasibility. The point of view of the operator conducting the assessment must first be specified. If we consider the point of view of the private stakeholder, e.g. the organisation or company producing the product or service, we must evaluate the Global Cost. In addition, the cost evaluation may be supported by a Cost-Revenue Analysis (CRA), which results in the estimation of economic performance indicators, such as: Financial Net Present Value (FNPV), Financial Internal Rate of Return (FIRR), Cost-Revenue ratio; Payback Period.

If we need to assess the economic feasibility of the project from the community's point of view, then we first estimate the WLCC and then evaluate economic performance indicators such as the NPV and IRR. An extended methodological explanation is in Appendix.

a.3) Assessment of environmental and social performance. This phase involves first the assessment of the environmental performance of alternatives, and thus key environmental parameters for circularity: greenhouse gas emissions, energy and water consumption, and resource use. In other words, depending on the product type of the strategies under analysis, one or more methods are implemented jointly, such as: LCA, MFA, EEIOA, emergy/exergy analysis. Thus, the analysis concludes S-LCA for the assessment of social and socio-economic impacts (both actual and potential) associated with the entire life cycle of a product or service.

a.4) Interpretation of results. It allows to synthesise the elaborations carried out in the previous steps and possibly define improvements/changes to the product/service in terms of its capacity to favour the transition to EC.

If the best CE strategy is to be identified among several alternatives, then the methodological steps to be implemented are as follows:

b.1) Identification of the stakeholders, goal, and selection of CE alternatives. After clarifying the actors involved and the goals, the circularity options to be evaluated are defined.

b.2) Choice of economic, environmental, and social criteria and indicators. The decision matrix is defined, i.e. the sustainability criteria and their evaluation indicators are established. The performance indicators summarising the results of: LCC-CBA (i), LCA-MFA-EEIOA-emergy/exergy analysis (ii), SLCA (iii) allow the economic, environmental, and social criteria of each alternative to be evaluated respectively. To guarantee a just transition towards the circular economy, we must give increasingly greater importance to the social dimension, including indicators that allow us to evaluate issues directly connected to work, gender and justice.

b.3) Choice of MCDM methods to be implemented. Depending on the specificity of the case studies, the goal and the availability of data, the most suitable multi-criteria technique is chosen or multiple MCDM methods are jointly implemented.

b.4) Evaluation of the weights and the scores and consistency checks. Once the hierarchical structure of the problem has been defined and the alternatives to be evaluated have been identified, it is necessary to evaluate: (i) the weights of each criterion and sub-criterion; (ii) the score of each alternative with respect to each evaluation criterion. The analytical formulations to be implemented vary depending on the MCDM method chosen.

b.5) Calculation of overall score and ranking of alternatives. The implementation of the MCDM method returns a ranking of the alternatives, allowing the best ones to be identified based on specific environmental, economic, and social performances.

The methodological approach is summarized in **Figure 6.1**.

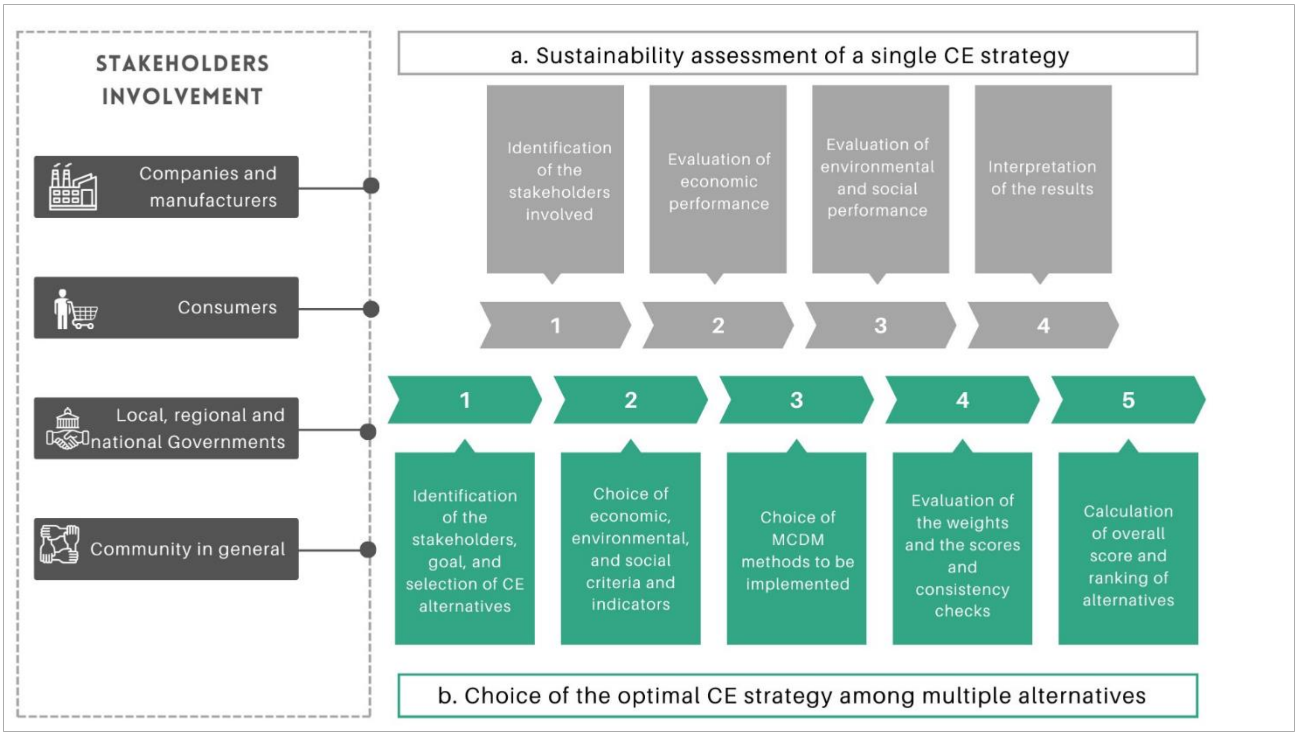

Figure 6.1 Steps of the proposed methodology

6.5 Conclusions and research perspectives

As the literature still lacks a quantitative and integrated methodological approach that can consider the perspectives of different stakeholder groups and help decision-makers select the alternatives that will enable a just transition to the CE, this paper: (i) analyses the shortcomings of current environmental, economic and multi-criteria assessment methods and techniques; (ii) defines a useful methodology to assess the sustainability of circular actions and strategies. It is a methodology that distinguishes: (a) the evaluation of a single intervention strategy; (b) the choice of the best CE strategy among multiple investment alternatives. In case (a), the following logical-operational steps are defined: (1) identification of the stakeholders involved; (2) assessment of economic feasibility; (3) evaluation of environmental and social performance; (4) interpretation of the results.

In case (b), the steps are as follows: (1) identification of the stakeholders, goal, and selection of CE alternatives; (2) choice of economic, environmental, and social criteria and indicators, including metrics that allow us to evaluate issues directly related to labour, gender and justice; (3) choice of MCDM methods to be implemented; (4) evaluation of the weights and the scores and consistency checks; (5) calculation of overall score and ranking of alternatives. The approach thus defined allows first to identify the stakeholders and apply integrated indicators to evaluate the CE strategies and their impacts (environmental, economic, and social). Therefore, it intends to represent a valid support for the decision-making process relating to transition strategies towards the CE, also allowing the different perspectives of the stakeholders involved to be included.

This study represents only the starting point of the research. Applications to real case studies will allow the proposed methodological approach to be tested and validated.

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Appendix

In order to be able to make an economic judgement on an investment, it is first necessary to define the point of view of the operator conducting the analysis. If the evaluation is conducted from the point of view of the private stakeholder, e.g. the organisation or company producing the product or service, the Global Cost is:

$$C_G = C_c + \sum_{t=1}^{n} \frac{C_m + C_0 + C_{el} - V_r}{(1+r)^t}$$

Where: C_c are the investment costs; C_m maintenance costs; C_o operation costs; C_{el} end of life costs; V_r residual value; t year in which the cost is incurred; n number of years of the analysis; r discount rate.
Depending on the product and/or service under analysis, the cost evaluation may be supported by a Cost-Revenue Analysis (CRA), which results in the estimation of economic performance indicators, such as: Financial Net Present Value (FNPV), Financial Internal Rate of Return (FIRR), Cost-Revenue ratio; Payback Period.
To assess the economic feasibility of the project from the point of view of the community, the WLCC is first evaluated:

$$WLCC = C_c + \sum_{t=1}^{n} \frac{C_m + C_0 + C_{el} + C_{ex} - V_r}{(1+r)^t}$$

C_{ex} external costs or externalities, including environmental and social ones.

Then the benefits of the initiative are assessed, and profitability indicators are estimated. If Economic Net Present Value (ENPV) is taken as the valuation indicator, then a project is economically viable when the sum of discounted present cash flows is positive and sufficiently large:

$$ENPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1 + r)^t} > 0$$

Where B_t and C_t are respectively the benefits and costs generated by the project at time t and r is the discount rate.

The Economic Internal Rate of Return (EIRR), on the other hand, can be defined as the discount rate for which the NPV is zero:

$$\sum_{t=0}^{n} \frac{B_t - C_t}{(1 + EIRR)^t} = 0$$

The project is economically viable if the EIRR is greater than the discount rate used in the analysis.

Chapter 7. Approaches underpinning CE policies and initiatives in the different regional contexts

Sanja Arsova, Andrea Genovese, Panayiotis H. Ketikidis

Abstract

The attainment of the European CE policies is strongly associated with initiatives at the regional level, because regions are in the optimal intermediate position to liaise upwards with their national government but also downwards to their municipalities and cities. Nevertheless, when it comes to regional implementation of the CE, there is lack of systematicity both in academic literature and policy documents. This chapter presents some of the main findings emerging from the conducted policy Delphi study. Namely, EU measures will need to take into account the protagonist role of the regions in vast numbers of vital aspects of the CE transition, as well as the importance of coordination for ensuring effective multi-level governance. An effective and functional institutional environment and responsive regional government institutions are conducive to the development of CE initiatives. Furthermore, the CE transition should encompass a place-based territorial approach, considering the specific regional strengths, opportunities and challenges throughout the policymaking process. Lastly, the smart specialisation strategies are perceived as fundamental delivery mechanism on the EU sustainability agenda overall.

Keywords: multi-level governance mechanisms; institutions; place-based approach; smart specialisation strategies; regional CE policies

This contribution will attempt to postulate crucial aspects and approaches underpinning the regional transition towards the CE, which need to be taken into account in the CE policymaking process and related mechanisms of implementation.

7.1 Introduction

Looking at the circular economy (CE) transition conundrum from a territorial perspective, in order to achieve a functional global circular economy in the long run, an alignment of actions on all governance levels is essential (European Commission [EC], 2015). The international and national levels provide high-level directionality and a unifying narrative of actions, while the regional and local levels are on the frontline when it comes to implementation through planning and accomplishing more tangible actions. More specifically, regions, through their policies and strategies, are playing a key role in promoting and reinforcing the underlying systemic changes needed to transition towards more sustainable and circular society (Vanhamäki, 2021). This is clearly reiterated by Strat et al. (2018) '*A functional global circular economy can be built incrementally starting from the interconnection* *of national circular economies that rely on interconnected regional circular economies'*, and graphically illustrated in **Figure 7.1**.

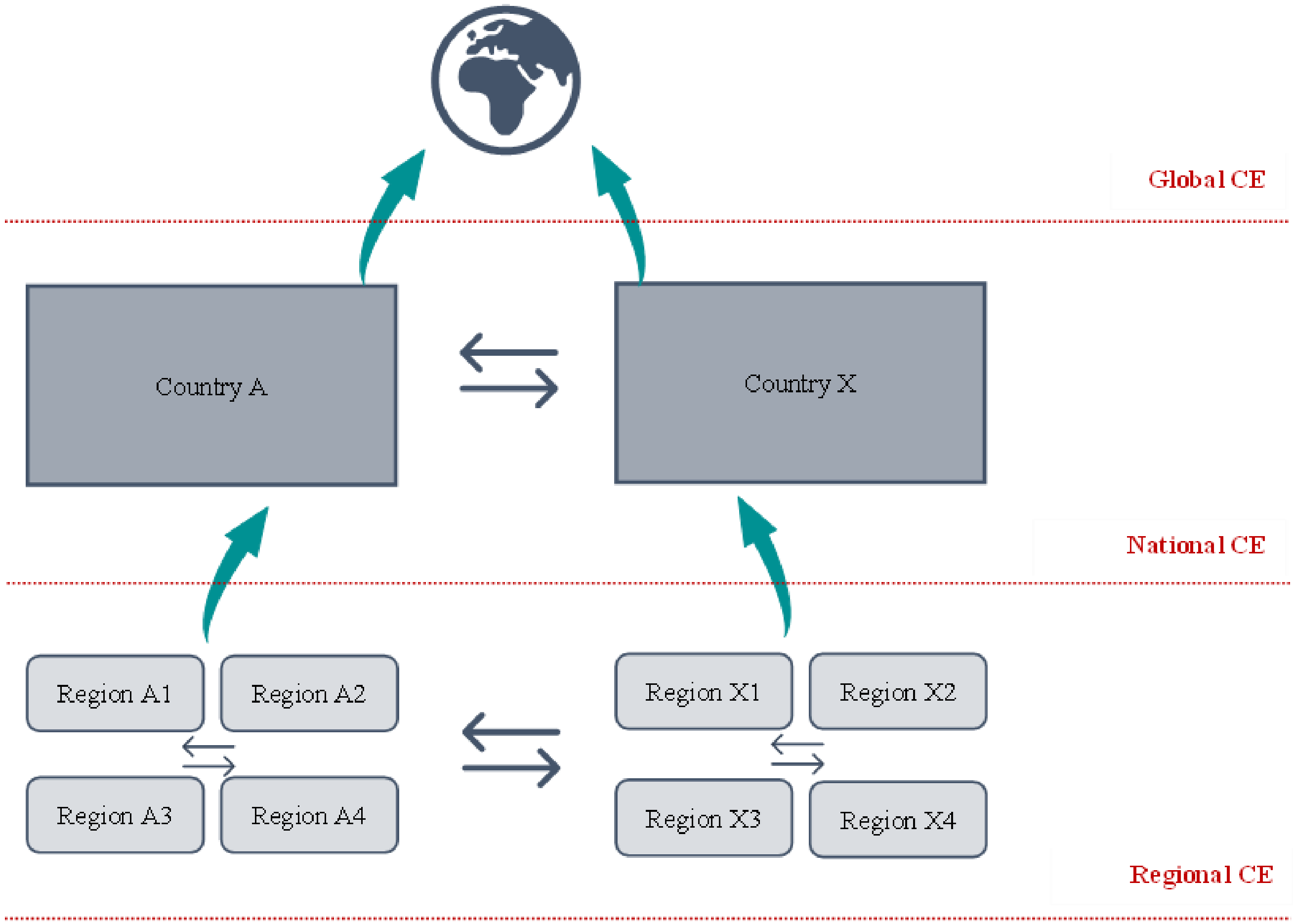

Figure 7.1 The importance of the regional circular economies and their interconnectedness – cascading upwards (Source: own elaboration)

In this context, this chapter is proposing regions (henceforth level 2 of the EU Nomenclature of Territorial Units for Statistics (NUTS 2) is used when referring to regions), as the minimum optimum unit for formulating and implementing CE policies. Regions are the most important administrative units of the EU's development policies (e.g. Cohesion policy, S3) and regional funds allocation (e.g. ERDF, ESF, CF) and so forth, have been widely used for devising and attaining strategic priorities. According to Barbero and Pallaro (2018), regions are vital for supporting the realization of EU and national strategies and policy frameworks because they are situated in an intermediary position to detect and address multi-faceted challenges which often entails inter-institutional policy response at all governance levels (Arsova et al., 2022). Practitioners are considering regions as forerunners in the green transition, stimulating changes way before national frameworks are devised. This is due to their scale and controllable economic systems; their proximity to environmental, social, and economic issues; and their ability to leverage on the local experience of relevant stakeholders (CIRCTER, 2019). Moreover, in EU Member States (MS), regions have the legislative power and regional autonomy to devise regional laws, adopt a wide range of policies in different sectors, and manage EU structural funds.

Henrysson and Nuur (2021) claim the predominant literature and policy discussions have taken a technological and industrial purview; however, the cardinal point of success of the CE model relies heavily on the relational dynamics which underlie industrial, regional, and national development. A specific socio-technical regime, like the CE, is conditioned by local and regional factors (Henrysson and Nuur, 2021) and the corresponding local institutional arrangements avail sub-national territories to embark on a sustainable journey to economic development (Rodríguez-Pose, 2013). This is attributed to the more efficient functioning of these institutional arrangements at the local and regional scale, as the national scale is perceived to be secluded and detached to successfully mobilise stakeholders (Rodríguez-Pose, 2013). However, the geo-political dimension in the dissemination of the CE concept and its implementation need to gain greater attention, because the CE solutions are not universal; hence, they cannot be replicated in different geo-political spaces without careful consideration of their specific context. According to Przywojska et al. (2021), contexts differ considerably and respectively, stakeholders encounter analogous environmental, social and economic challenges. Therefore, a territorial anchoring of the circular activities is needed, because omitting the dynamics of geographical proximity in CE approaches would mean disregarding the environmental dimension of the CE, which is central (Bourdin et al., 2022).

Most of the CE discourse development has been carried out by the private sector or governments, and in academia the emphasis was given to debating the conceptual boundaries of the CE paradigm, along with the actual implementation of CE practices on company and supply chain levels (Vanhamäki, 2021). The application of the CE concept at the regional scale and the related regional policy fora is still in the infancy stage, though increased interest has been noted recently (Arsova et al., 2022; Vanhamäki, 2021). In light of this, this chapter attempts to address these under-investigated areas and enrich the knowledge base on the formulation and implementation of CE policies at the European regional level.

The structure of the chapter is as follows: **Section 7.2** provides the research context by presenting the main findings from the conducted literature review, ultimately identifying the main research question to be addressed. **Section 7.3** describes the research methods applied to this study. Namely, the four-stage policy Delphi method that was designed for the purpose of this study and the subsequent template analysis which followed. The emerging findings are presented in **Section 7.4**, providing an overview of the predominant approaches for the development of CE policies and initiatives in the EU regional context. The main concluding remarks are provided in **Section 7.5**.

7.2 Literature Review

The vital role of local and regional authorities in initiating and promoting the CE transition has been underlined in several recent studies (Scarpellini et al., 2019; Silvestri et al., 2020; Arsova et al., 2021; Arsova et al., 2022), and according to Bacova et al. (2016) consists of establishing framework conditions or directly encouraging local and regional actors (Silvestri et al., 2020). Moreover, as stated in Bacova et al. (2016), "*since CE implementation is affected by geographic, environmental, economic and/or social factors, the diversity of territorial contexts translates into different needs and opportunities that any CE approach should address*". Lechner et al. (2021) added that even though policymaking is perceived as a mainly (trans)national way to address sustainability issues on a large scale, local authorities have an important influence on climate mitigation activities.

Kokkinos et al. (2020) emphasize the role of regional authorities in the renewable energy transition, being mostly directed towards spreading awareness and informing the local society and industry for the benefits emerging from actions towards cleaner technologies. The regional level is perceived to be crucial also for employing waste management policies since regions and municipalities are accountable for separate collection systems and for creating and overseeing treatment facilities. For example, as discussed in Arsova et al. (2021) in Italy, the waste policy is devised nationally, while regions formulate their own waste management plans and govern how waste management is applied, and local governments manage municipal waste collection and treatment (Committee of the Regions, 2020). Therefore, the CE initiatives in practice are predominantly developed regionally, due to the competencies and legal powers at the regional level.

Savini (2019) claims the popularity of CE policymaking has gained momentum along with a culture of ecological production and consumption. The concept of presumption emerges in this context, emphasising the role of households (both as producers of waste and consumers of reprocessed waste materials) as vital for closing the urban chains of waste supply and demand. The outcomes of a recent study of the Brussels capital region's urban policies provide support for this conclusion. In territories with high consumption and limited production activities and resources, environmental policies must shift focus to the consumption side to impact circularity and climate change more effectively (Christis et al., 2019). Towa et al. (2021) proposed different CE actions for regions to increase their circularity and reduce their circularity gap. Nevertheless, these interventions must be developed with an *"integrated approach nesting inputs and outputs"*, and they should not imperil a shift of environmental challenges. Additionally, in the new global economy, the interconnectedness effects of countries and regions shall be considered and incorporated into foreign policies both at the EU and international scale (Towa et al., 2021a).

Real et al. (2020) refer to the work of Manzini (2013) related to the concept of cosmopolitan localism, described as a web of *"interconnected localities, where many important decisions are made locally by the people directly concerned, and more importantly, where for each step of the process of production and consumption, much of the decision-making, know-how and economic value remains in the hands, minds and pockets of the local communities"*. In this context, the CE is delineated as a network of smaller circular economies, where in order for a transition to happen certain settings need to be enabled which correspond to the local contexts, like regulation, policies, infrastructure, and user's conduct. This is closely linked to other concepts, among which are degrowth (Demaria et al. 2013), diseconomies of scale and opposition to bigness (Kohr, 1957) or conviviality (Illich and Lang 1973), all of which require change-makers to create socio-technical transitions in small territories such as cities or regions (Real et al., 2020). Nevertheless, according to Genovese and Pansera (2021), the governance and political implications are scarcely contested in CE literature, while the emphasis is firmly put on the technical feasibility, entirely depoliticizing its effects. This kind of technological optimism prevents scholars to challenge economic models which bring uncertain contributions to sustainability and perpetuates the idea that GDP growth can continue forever by simply recycling waste into new productive inputs (Corvellec et al., 2021). The technocratic outlook of the CE is grounded on the rift between a holistic discourse and end-of-pipe policies, anchored on growth and competitiveness rather on socio-ecological challenges. Hence, EU policies are only intended to advance circularity, rather than hindering the linear economy legacy (Corvellec et al., 2021).

The policy review performed by Stanojev and Gustafsson (2021) uncovered that CE should be perceived as a wider sustainable development strategy which should also *"support Member States and regions to strengthen innovation for the circular economy through smart specialisations"*. The work of Vanhamaki et al. (2021a) presented an original approach to investigate the spatial implementation of a CE using a conceptual framework of smart specialisation strategies (S3)[1] in EU regions. One of the main suggestions was regions to concentrate on precisely denoted objectives and specific but amendable plans on how to attain the targets, with the purpose to take advantage of both S3 and CE. Despite the fact that both S3 and CE are novel and still in development, hence good regional practices of combining both are still not available, the potential for synergies between these two approaches shall be acknowledged. Henrysson and Nuur (2021) highlighted the need for policy interventions, beyond sectoral involvements or requirements for more circular product design, in order to transition to a more CE. Namely, they call for policy actions directed towards local factors being crucial for establishing and maintaining institutional environment supportive of CE-based transformations.

Compagnoni (2020) also argues that regional authorities have indispensable role in implementing CE, because local challenges and opportunities related to CE adoption can be very specific. Three key instruments have been used by Italian regional authorities to introduce the CE principles at the regional level, namely, the Research and Innovation Strategies for Smart Specialisation, single regional laws (RL) and Regional Waste Management Plans. The S3, although considered as the most holistic instrument providing a multi-faceted policy mix based on medium-long run regional development ambition shared by many actors, was the least used one; only Emilia Romagna region explicitly mentioned the CE in its S3, while Piedmont and Lazio region included some close related notions to CE.

Sutcliffe and Ortega Alvarado (2021) studied the introduction of the CE concept in the Norwegian subnational levels, through the domestication framework in order to analyse how locality and cultural context influence the translation of global policies into local practices. The CE roadmap of Päijät-Häme region, one of the first regional CE strategies (Vanhamaki et al., 2020) devised by local government, industry, and academia, aimed to close technical and biological loops, and encourage sustainable energy technologies, new consumption models and demonstration sites (Sani et al., 2021). When the Päijät-Häme road map was launched, only big EU cities had CE strategies of plans like Circular Amsterdam (2016), Circular Glasgow (2016) and the London CE Route Map (London Waste and Recycling Board, 2017) (Vanhamaki et al., 2020). On the other hand, the focus of the Regional Programme of Brussels Capital Region was on the urban political economy of the CE (Sani et al., 2021). Overall, the CEAP (2021) appears to be largely focused on waste and carbon footprints reduction, increasing durability, reutilisation, reparation and recycling of products and promote digitalisation. When it comes to the social aspects of the transition, they seem to be limited to the encouragement of good practices for consumers, and overall, the issues of justice (social, geographical and gender), remain unanswered by the CE literature, mainly because the social and ecological benefits are wrongly conceived as by-products of the transition and assumed to be achievable by simply decoupling economic growth from the environmental impacts (Ripa et al., 2021).

The policies and legal frameworks stimulating CE are differing cross the world (McDowall, 2017), conditional on the political system and governance structure (Cramer, 2020). China on one hand is promoting the CE as a top-down national political objective, while, on the other hand, Japan, the USA, and EU countries are more reliant on devising bottom-up environmental and waste management policies (Ghisellini et al., 2016; Vanhamäki et al., 2021a). Similarly, Gravagnuolo et al. (2019) label the Chinese and European cities as leaders in the delineation and application of the circular city concept. However, the difference between their approaches is evident. The strategies

[1] An innovative approach aiming to boost growth and jobs in Europe, by enabling each region to identify and develop its own competitive advantages.

of the Chinese cities are instigated by top-down national policies, while those of the European cities take a bottom-up, place-based stance, adopting diverse approaches depending on their resources and local challenges. More importantly, the strategic action plans for the CE transition of many European cities/city-regions are devised with the participation of consultants and local stakeholders (businesses and civil society organisations). Nevertheless, the 'apolitical' nature of the CE concept, being one of its main points of criticism, along with the ambiguity delineates the CE as an 'empty' signifier, availing different actors and sectors to articulate circular discourses depending on their political and economic agendas (Calisto Friant et al., 2020). Therefore, the need for more fundamental questions to be asked transpires, as stated in Ripa et al. (2021), such as: who is advocating the CE, which narratives they are using, which new socio-economic dynamics, regulatory challenges and trade-offs emerge from subsequent changes in supply chains and production and consumption processes, how is the CE discussed/understood differently across municipalities/states/regions and with what effects for their local/national/global regulation.
Therefore, the main research question that this chapter will attempt to address is *"what are the underpinning approaches fostering the emergence and development of CE policies and initiatives in different regional contexts in the EU?"*

7.3 Materials and Methods

7.3.1 Policy Delphi study

This study adopted a policy Delphi method, considering the main research question is related to the development of regional policy frameworks in the CE area. The policy Delphi, applied when dealing with social and political matters, is deemed more suitable in the social sciences compared to the classical Delphi (van Zolingen and Klaassen, 2003). The method includes a collection of data from experts in multiple rounds (van Zolingen and Klaassen, 2003; De Jesus et al., 2019; Campbell-Johnston et al., 2021) and the ultimate goal is to generate policy alternatives by adopting a structured public discussion (Fache´, 1993).

The Delphi method has been applied in the CE literature so far. Campbell-Johnston et al. (2021) adopted a policy Delphi to investigate the outlooks on improving Extended Producer Responsibility (ERP) policies to contribute to the CE targets in the Netherlands. De Jesus et al. (2019) also used policy Delphi method to uncover the CE's core characteristics and evaluate the trade-offs which must be coped with for the transition, while Mahanty et al. (2021) and Sharma et al. (2018) used the classical Delphi method. To the best of the researcher's knowledge, no study so far has adopted policy Delphi to investigate the implementation of CE policies in the context of European regions. The policy Delphi was structured in four interrelated phases (**Figure 7.2**).

Phase 1 involved the nomination, selection and contacting of the experts. In total 169 regional policy experts were being reached mostly via email, but also via LinkedIn messages. In *phase 2* a short online survey was coded using the Qualtrics software and distributed to selected policy experts from *phase 1*. Before distributing the survey to the regional policymakers, an internal pre-piloting and piloting was conducted, testing the functionality but also the validity of the questions. In total 42 experts responded to the survey, representing 20 EU countries and 32 EU NUTS 2 regions (**Table 7.1**).

In the online survey, the experts had the opportunity to express their interest to participate further in the research, by agreeing to take part in an individual interview. Hence, in *phase 3*, semi-structured individual online interviews were organised with 19 experts, which aimed to tackle the hidden complexities of the area of research, which could not be captured in the survey. Ten (10) experts which responded to the survey also participated in the interviews. In two cases the participants of the survey suggested their colleague to participate in the interview, and the remaining 7 participants were recruited subsequently using a snow-balling technique, to mobilise additional knowledge, each one of them in their area of expertise. It has to be noted that not all of the experts were regional policymakers; some were policy analyst or directors working in EU institutions, eminent academics in the field of environmental sciences and regional development policies, project managers. All interviews were conducted online and recorded using the ZOOM platform. In total the video recordings amounted to 13 hours and 20 minutes (or 800 minutes) of recorded conversation, which then were transcribed by the lead researcher, using the standard (non-verbatim) transcription style.

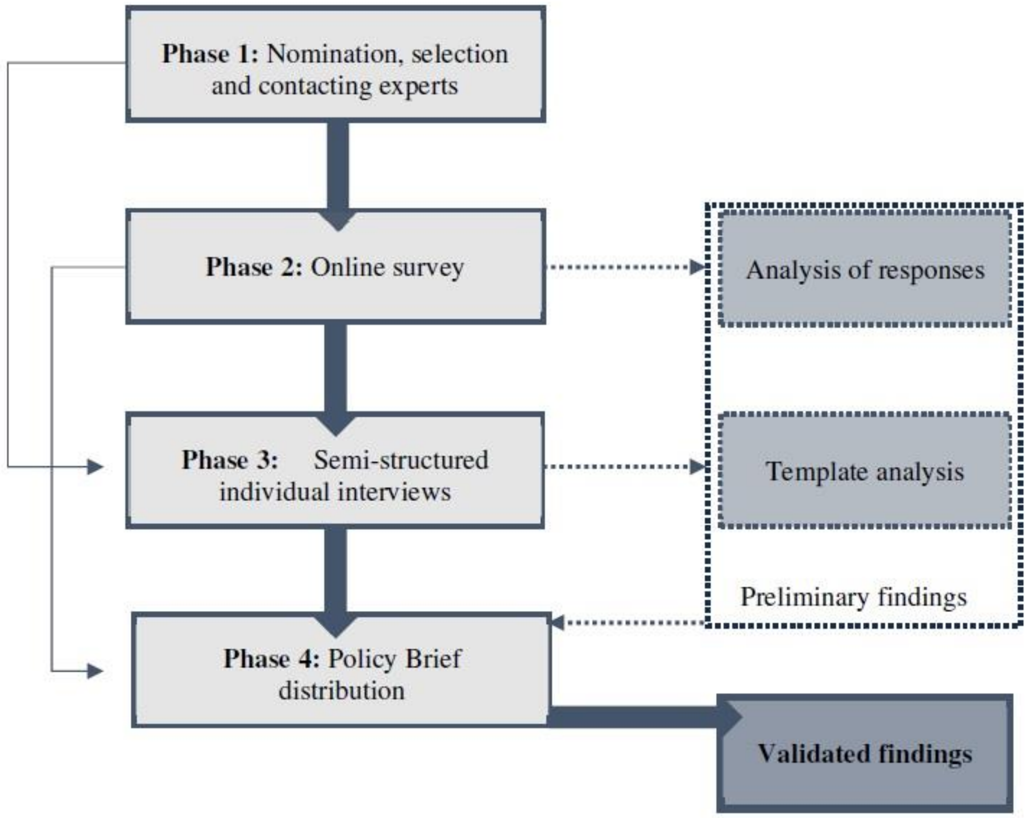

Figure 7.2 Policy Delphi study – process and data analysis

In the last phase, *phase 4*, a Policy Brief was developed with the main findings of the study from the previous phases and distributed for validation to 43 policy experts which participated in one or both previous phases of the study. In total, 10 experts provided feedback, 8 through mail and one through an online discussion which was subsequently transcribed. The feedback was collected, and the validated version of the Policy Brief was processed for subsequent analysis.

The length of the study including the primary data collection lasted roughly 14 months, from 12th May 2022 when the survey was distributed until 16th July until the final feedback for the Policy Brief was collected.

Table 7.1 Surveyed NUTS 2 regions and number of respondents per region

Country	Region	Number of respondents
Austria	Upper Austria	2
Belgium	Brussels Capital Region	3
	Flanders	1
	Wallonia	1
Cyprus	Cyprus	1
Czech Republic	Prague	1
Denmark	Capital Region	1
	Central Jutland Regions (The Central Denmark Region)	1
Finland	East and North Finland	1
	West Finland	1
France	Pays de la Loire	1
Germany	Weser-Ems	1
Greece	Region of Central Macedonia	3
	Western Macedonia	2
	West Greece	1
	Eastern Macedonia and Thrace	1
Hungary	North Great Plain Region	1
Italy	Emilia-Romagna Region	1
	Tuscany	2
	Marche Region	1
Lithuania	Capital Region	1
Luxembourg	Luxembourg	2
Poland	Malopolskie	1
Portugal	Madeira	1
Romania	North-East Region	1
Slovakia	Western Slovakia	1
Spain	Galicia	1
	Basque Country	1
	Catalonia	2
Sweden	Stockholm	1
The Netherlands	Friesland	1
	South Holland	2

7.3.2 Data analysis procedure

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

In terms of coding approaches, hierarchical coding was applied, meaning narrower more specific themes were nested into broad overarching themes. Parallel coding was also applied where deemed appropriate, implying same segment of text was categorised within more than one different code and theme (Brooks and King, 2014). The coding was performed manually using MS Word, due to the low number of interviews. In this study a mixed approach was used, combining the deductive nature of the *a priori* themes emerging from the literature, and survey results on one hand, and the new themes emanating from the interviews on the other hand, representing the inductive nature of the process.

7.4 Results

7.4.1 Underpinning approaches for regional CE transition

Considering that each region will transition in a territorially differentiated manner, a deep analysis of the regional narrative is the starting point. Hence, careful consideration of the regional structural aspects is indisputably a precondition, entailing on one hand the place-based approach anchored on regional strengths, but simultaneously considering the challenges the region is facing along with the emerging opportunities on which the region can leverage. Equally important are the regional dynamics characterised by different idiosyncratic factors including geographical, economic, social, environmental, political, cultural, and technological factors, along with the industrial structure of the region, particularly in the regions with natural resource-based industries (NRBIs). In these regions where the regional strength is in NRBIs, the transitioning challenge is greatest, also due to the EU commitments to phase out such unsustainable activities by 2030.

The role and importance of regions were overall recognised throughout the whole policy Delphi study, and it was perceived through two different viewpoints – considering the territorial level of policy implementation and the perspective of a regional authority. When it comes to the latter, a tendency for organisational transformation at the level of regional administration was observed, shifting the focus towards challenges and transitioning themes in order to better align the organisational structures with the goals of the CE transition. In that context, regional efforts for establishing a transversal coordination unit extending beyond departmental borders could be beneficial, therefore adopting a holistic and systemic approach in the traditional departments at the public institutions.

The institutional structure and overall prevailing mentality in regional authorities proved to be vital for the development and adoption of CE policies because collaboration and trust required to undertake CE initiatives are fostered locally. Another essential issue to be addressed is to ensure perpetuity between political cycles, especially at the local and regional elections. The importance of having well-developed capacity and leadership skills at the regional level to envisage long-term vision and actions was also stressed, which makes regional authorities feel agency over their own future. An example of this is the unceasing determination of the Central Denmark region to vouch for early inclusion of the public sector in the CE transition by showcasing to the Ellen MacArthur Foundation that public sector should be part of the CE travel, as well as their ability to cooperate for lobbying on CE agenda inclusion in the national policy bills. However, the lack of regional capacities to plan, design and execute CE strategies was noted, as well as the uneven availability and distribution of skilled public servants in regional authorities working on the CE transition. An investment in human capital and tools needs to be made in order to address the lack of capacities in regional administrations.

Regional autonomy is another important determinant, which is being reflected in a rather fragmented legislative landscape within the EU. Namely, based on the division of power the EU regions are split into regionalised Member States (MS) and unitary MS at the two sides of the spectrum. In the regionalised MS the sub-national level, i.e., regions, have legislative powers, therefore a statutory delegation of power is exercised by the central government, i.e. devolution. Regions are having regional autonomy to devise regional laws in certain sectors and therefore have wider range of instruments disposable to mobilise regional stakeholders and initiate change. Simultaneously, this is one of the main challenges and caveats of regionalised governments, because it can often instigate a gridlock between the central and regional government. In unitary MS, the legislative power is entirely concentrated at the central government level, resulting in lack of regional autonomy, limited planning capabilities of the regions within these MS and general difficulties to advance centrally devised strategies.

Balanced distribution of power between formal and informal regional players was therefore deemed as ideal, ensuring harmonious symbiosis between central government and local level. In these instances, regions are playing an important role in the design and implementation of the policies, hence *"it's not a race against the government, it's actually a positive action for and with the government"*. These regions despite the lack of legislative power to devise regional laws are one of leading regions in the transition towards the CE, due to their strong institutional capacities, informal governance, organisation culture and value of regional authority being aligned with environmental affairs.

In that respect, the need to have a unified narrative towards the CE transition through the existence of a functional and efficient multi-level governance mechanism was underlined, including vertical and horizontal governance imperative. The vertical governance imperative emerged as highly important for the CE transition and in this respect the balanced distribution of power played a dominant role. The issue of coordination transpired in this discussion, where opposing views were noted. Some regions focused on ensuring directionality and transformative action, rather than coordination, while for others the lack of coordination was underlined as the main impediment to advance towards a more circular future, by decelerating the transition process and increasing the complexities. Hence, the establishment of some type of coordination body was deemed indispensable, and this need can be utterly met with the establishment of regional and national CE hubs. At the EU level, the formation of the CCRI CSO (Coordination and Support Office) was envisaged to tackle the coordination issue in order to overcome the challenges for CE transition. The horizontal governance imperative among different regional authorities and provinces was also stressed as instrumental for the CE transition in several interviews. In this setting, *"the regional level is so efficient, as the particular regional governance is developed"*. Lastly, in the CE transition, it is fundamental that the interplay between all governance levels is maximised. In this context, the EU plays a central role, by pushing for collaborative learning and bringing all relevant stakeholders together for knowledge exchange.

Both the EU Green Deal (EUGD) and the Circular Economy Action Plan (CEAP) are formulated and implemented following a very top-down approach, which certainly has the advantage of providing a unified directionality. However, the very top-down approach has the tendency to be auspicious for the already advanced regions, neglecting the needs of the weaker ones. Additionally, the increased environmental top-down conditionalities related to the EUGD funding instruments are raising the risk of squeezing out innovation due to an additional web of requirements, leaving regions with fewer degrees of thinking freedom. But without the bottom-up approach, a lot of conflicts and frustrations are generated; hence more balanced interventions are needed and ways to increase the interaction between both approaches.

In terms of the links between S3 and regional CE, a mutual interaction between the two policies was uncovered. A constant interplay between the two strategies was defined, and this is becoming more widespread lately, due to increased awareness of the CE idea. However, a less deterministic relationship appears to exist with several risks of adverse influence, including risks of regional lock-ins in linear supply chains and potential negative path-dependency situation.

7.4.2 Architecture of CE policies and initiatives in different regional contexts

Overall, it was deemed beneficial for a region to have a regional CE strategy or policy, mainly for two reasons, it provides an overall vision and directionality. Additionally, by developing a regional strategy, the region can leverage on funding indispensable for transition. Nevertheless, the interlinkages between the existence of regional CE policy and the level of CE advancement were characterised as nuanced, since there are regions which are very advanced in a particular field but don't have a CE strategy per se. Some essential determinants which need to be considered during the formulation of regional CE policies emerged, like the entanglement of the place-based approach since there is no "one-size-fits-all" solution. This was evident in the case of the Galician CE strategy, where the main focus was on food value chains because this sector is very important for the region. The systemic changes required for the CE transition were also mentioned, as well as the need for system boundary delineation. General EU guidelines in this respect were deemed as helpful both for regional and sectoral scales. The last determinant to be considered, particularly for the national level is to provide an overall framework where regional authorities can innovate based on their local situation and try to strike the balance between compliance and "room" for innovation.

An attempt was made to categorize the regions based on the existence of a regional CE strategy, policy or action plan and its specifics. For instance, the region of Galicia has a standalone CE policy, the *Galician Circular Economy Strategy for 2020-2030,* and it has a twofold aim – to be aligned with the main EU policies and the regional S3. South Holland region also has a standalone CE strategy, but recently they developed a very industry-specific strategy looking at the regional logistics hubs, like the Rotterdam harbour in the CE transition. Brussels Capital region is another example of a standalone policy, *Brussels regional circular economy program of 2016-2020*. Catalonia has many regional policies addressing environmental issues, but the most relevant strategy is the *Bioeconomy strategy*. Additionally, the Catalonian S3 for both programming periods had CE as a transversal priority and therefore, a central element of S3.

The Region of Central Macedonia doesn't have a CE policy, but it has two related action plans resulting from ad-hoc EU projects, *Action plan for promotion of circular economy within the SMEs* and *Action plan towards biobased circular economy*. Furthermore, CE is one of the priorities of the National S3, and indirectly of the Regional S3 since they both have to be aligned. Marche region likewise doesn't have any regional CE strategy and has no intentions of developing one soon. Nevertheless, CE is quoted many times in their regional S3 as one of the main sectoral drivers. Similarly, the region has a *Regional Law on Industry 4.0*, focusing on promoting digitalisation, modernisation, and sustainability of businesses and the CE is part of it. The twin transition, green and digital, was additionally brought up in other discussions. Slovakia is another example where regions don't have developed their CE strategies, but the current National S3 (*Research and Innovation Strategy for Intelligence Specialisation of the Slovak Republic 2021-2027)* contains CE elements. Upper Austria has a wider sustainability agenda, called Upper Vision 2030, but furthermore has a roadmap for the plastics value chain. Central Denmark region has a wider

Sustainability Strategy for 2030, where CE is one of the main focus areas, and moreover, they have a Sustainability Strategy focused on the plastics value chain in hospitals. In other instances, like Poland, CE policies on other levels like national and city level (Krakow, Warsaw, and Gdansk) were mentioned, despite the existence of few regional policies in Malopolskie and Śląskie region.

Additionally, an attempt was made to present the diverse scenarios among the EU regions which led to the initiation and formulation of CE policies or related activities. In the case of South Holland region, the CE strategy development was influenced by two factors from a political nature. Namely, the last provincial elections had a deputy with CE related political agenda, combined with the organisation transformation resulting in a shift of organisational structures and modus operandi. The latter one was also quite deterministic for Catalonia, where a shift from an overarching CE regional policy to the integration of CE elements in a wide range of existing regional policies was observed. Both cases are the result of strong regional initiatives coming from the regional authorities. The Galician government was another example where the regional government contracted the formulation of the strategy, following the priorities coming from the EU. The policy formulation was initiated by the regional government, and drafted by three universities, considering the feedback of the Triple helix actors, industry, academia, and government, but omitting the involvement of societal actors.

Central Denmark region was another example where CE-related activities were undertaken even in 2010, originating from the genuine interest of the regional authorities in the CE agenda. This was founded on normative and innovative approaches to mobilise the regional ecosystem, by initially establishing a platform enabling to work on CE-related issues. The outcome of this was their first strategy, called the Innovation Strategy, developed following a co-creation approach. In parallel, the region was working with SMEs, by initiating a program for SMEs interested in CE transitioning. There were also very effective vertical governance mechanisms for cooperation, because the region was also engaging the municipalities by providing municipal funding for CE-related projects, involving Triple helix actors, and municipalities had the obligation to include these CE actions into their municipal strategies. Subsequently, the region shifted their efforts towards value chains, trying to ensure every partner along the value chain had value from cooperating towards CE. Therefore, they identified "piloting" areas for testing and gaining knowledge, focusing on a project on plastic packaging in hospitals.

On other occasions, certain regional policies were formulated following a top-down conditionality, either coming from the EU or national governments. The *Sustainability Strategy 2030* of the Central Denmark region was a legal demand coming from the Danish national government. On the other hand, the Galician case was an example where the EU policies and priorities were more influential than the national ones, pointing out a potential disjuncture of the transposition process. Nevertheless, the impediments to these EU initiatives reaching all regions simultaneously were also highlighted since this will require a particular governance structure and a more focused approach targeting specific areas. In this context, it was noted that there is also an upward channel of influence because the actions of the regions are affecting the EU policies in turn. This top-down conditionality is inevitably increasing the compliance and requirements at regional and local levels, which bears the risk of strangling the innovation. Poland was another interesting example, where due to EU law the countries were obliged to have National Waste Management Plans as well as Regional Waste Management Plans, and recently regions started converting the latter ones into regional CE plans, as a response to the latest developments. However, these plans are very sector-specific, mostly focusing on waste management, industrial and municipal because this is the easiest way to report good results, as stated in one of the interviews. Despite the lack of regional CE policy, the Marche region has scattered CE-related activities undertaken within different EU projects but has no CE strategy.

Lastly, an attempt was made to show the different stages of CE policy implementation among participating regions, along with some of the main challenges they are encountering. The CE concept started penetrating in related policies and discussions at the regional level, however, there is still a time lag between West and North Europe, compared to South and East Europe. For example, CE-related discussions that have existed in Brussels since 2013 have only now started appearing in Western Greece. Catalonia was one of the most advanced regions when it comes to CE adoption, where CE is becoming business as usual, according to the participant. The CE policy has already penetrated in a wide range of existing regional policies, and there is integration of the CE concept. Western Macedonia region is in the process of formulating regional CE policies. Similarly, Slovakian regions will need to devise regional policies due to regulatory compliance in the current programming period 2021-2027. Despite not having a CE policy, the CE concept started penetrating in related policies in the Marche region, as well as different scattered CE activities have been undertaken within EU projects, like the establishment of the regional reuse centre. In other regions, there is a lack of realisation observed due to different reasons. The immaturity of the CE concept was raised not only in Malopolskie region but in Poland overall, as well as in the Region of Central Macedonia where additional difficulties were faced in the CE implementation on the industry side since SMEs seem disengaged with the CE agenda. In other instances, like for Galicia, policy prioritisation issue was observed, because of the political agenda. For the South Holland region, a lack of regional enforcement mechanisms was noted, since occasionally tasks from the national government were delegated without adequate budget allocation for implementation.

7.5 Conclusions

This chapter provided an overview of the current approaches underpinning the CE policies and initiatives in different European region, and how did CE transitions unfold across different geographical contexts. Namely, the CE transition will entail a place-based perspective, as each region will transition in a territorially differentiated manner; hence, policy actions directed towards local factors are crucial for establishing and maintaining an institutional environment which is supportive of CE-based transformations. In this context, the rigidity of institutions and inflexible organisational structures were mentioned as existing obstacles, as well as the insignificance of the level issuing the regulation for the stakeholders; what matters is the availability of funds, directionality and new regulations that "*indicate the landscape is changing*". Balanced distribution of power between formal and informal players was deemed as ideal, with functional and efficient multi-level governance mechanism in place (both vertical and horizontal), allowing interplay maximisation between all governance levels. Overall, the configuration of the CE policies within EU regions appears to be wide and diverse, ranging from no policies in place (but scattered CE activities undertaken within the region), to existence of a standalone CE strategy, action plan, or wider sustainability agendas which entail CE elements. Similarly, the initiation of regional CE policies seems to be diverse, some following top-down conditionality, while others being initiated on an initiative of the regional government. In terms of stages of implementation of the CE policies, the picture was also scattered; on one hand we identified regions where CE was perceived as business as usual and the CE concept has penetrated in wide range of existing regional policies, while on the other, we found regions not knowing from where to start from. The CE concept started penetrating in related policies and discussions at the regional level, however, there is still a time lag between West and North Europe, compared to South and East Europe. The main challenge therefore is whether the CE transition, with its 'apolitical' current framing and related implementation instruments, will act as a potential accelerator of the divide, ultimately creating a two-speed Europe. In light of this, the distributional aspects (who gets what environmental benefits and burdens) and related justice need to be considered in the systemic transition not only towards more circular but also a more just future. Therefore, the geographical (and social) distribution of benefits and burdens from CE transitions and policies should be further explored, taking into account the territorial polarities, inequalities and shifting power dynamics which could transpire.

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Chapter 8. A Diversity of Paths Towards Social Transformation Through the Concept of a Circular Economy

Kosheek Sewchurran, Gavin Andersson and Lester M. Davids

Abstract

This paper contrasts conceptions of the CE in the GN with those in the GS. Appreciating the apparent differences in ontology we can see that such ontological choices imply different levels of transformative impact. Further, these choices manifest different appreciations of leadership and organising. Specifically, we see that the southern approach fosters leadership that is more collaborative and inclusive, to yield ongoing co-development of power, agency, and directionality. This ultimately generates ongoing acts of transformation at individual and collective levels. In addition, the southern practice shows the functioning of being in tune with a complex adaptative system that is an unbounded organisational ecosystem. Circularity thus invariably involves leadership which supports the development and transformation of this ecosystem. In a southern conception leadership and organising are appreciated for their collaborative, dialectic, spontaneous and momentary value to produce transformative values that arise from within the flow of practice.

Keywords: circular economy; ecosystems; unbounded organizing; regenerative agriculture; leadership-as-practice

We address blind spots resulting from understanding the circular economy as a thing, or entitative reality, as opposed to processual, ongoing emergence. This latter view enables appreciation of how social transformation and a 'just' transition might happen as durational impacts.

8.1 Introduction

the case studies developed in the JUST2CE project show that the interpretation and application of the concept of 'circular economy' differs in the GN and the GS. An adequate definition of the circular economy from a northern perspective is provided by the Ellen McArthur Foundation, which sees it as a "systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution. It is based on three principles, driven by design to: **eliminate waste and pollution**, **circulate products and materials** (at their highest value), and **regenerate nature**." (*Ellen MacArthur Foundation, ellenmacarthurfoundation.org)*. The accent is thus on environmental issues, and ways of optimising the work process and associated value chains so that there is a reduction or reuse of waste. European Union policies based in this understanding focus on reducing carbon and other emissions and reducing manufacturing costs through reuse and repurposing of materials.

The circumference of the circular economy in the imagination of the GN is most often the enterprise and associated value chains. There are few sociological referents, and environmental factors are considered only with respect to the impact of the individual enterprise. Thus, in manufacturing, circularity is often seen as using the endpoint of one process as the starting point for another, and the design of products with a view to their reuse or biodegrading; the search is for a cradle-to-cradle process (McDonough and Braungart, 2002). While recognized pillars of the circular economy include employment policies, training, social inclusion, and sustainable development more broadly, the application of the concept in the GN often sees the social dimension reduced to enabling consumer choices, helped by the development of certification systems (CEAP, 2021). Social aspects of production or service - such as labour practices, societal inequality, local organizational ecosystems, or gender issues – tend to be ignored by most of the mainstream literature on the topic (Mies et al., 2021).

In cases from other parts of the world, the concept of the circular economy can have a much broader range of interpretations, shaped by the concerns emanating from local contexts and different populations and cultures (Kirchherr, 2017). The GS has expanded the concept of circularity to include social concerns such as improving the well-being of communities in which enterprises are located (Schröder et al., 2019). The southern imagination of circular economy tends to traverse unbounded space, to look at each enterprise in its ecological setting and its organizational ecosystem. Northern conceptions are embraced, but there are now also concerns about the social relations within the enterprise and across the wider unbounded terrain. This is on reflection a matter of common sense in settings which are marked by extremes of inequality, so that there is an imperative for transformative action. The concept of circular economy moreover comes at a moment when the consequences of epistemological devastation of indigenous worldviews becomes manifest in the catastrophic effects of the GN's historical imposition of extractive one-way flows of materials and surplus. In this context circularity assumes a philosophical centrality and recalls indigenous cosmologies of wholeness and systems integrity.

8.1.1 Insights from case studies

The series of case studies that inform this essay were conducted under the rubric of the Just Transition to a Circular Economy (JUST2CE) as part of the Horizons 2020 European project, coordinated by the University of

Barcelona. The ten case studies are unique and diverse: they span across different countries in the GN (Italy, Spain, Portugal, United Kingdom) and in the GS (Morocco, Ghana, Zimbabwe, Ethiopia, South Africa). Moreover, they examine different industries (plastics, agriculture, fishing, fertilisers, electronics, steelworks etc.), as well as different scales of analysis - from local to global initiatives - and different institutional structures (from bottom-up informal recycling initiatives to large government megaprojects).

Two studies have special salience for this essay. The case of Minga in Portugal concerns a rural landscape that had been impoverished as a result of barriers to market access brought by new regulations and bureaucratic constraints of the EU. In essence, this setting is a microcosm of international divisions: the municipality of Montemor can be seen as an example of the GS within the GN. Here planned moves towards a circular economy saw organisation across districts and involving many enterprises; a departure from most examples of CE in the north (Gonçalves, Sousa and D'Alisa, 2023). Further evidence of this was that interviewees offered their interpretations of what CE meant by focusing on relationship and mutual exchange of proximity products among locals, which is more in line with a GS approach to CE that values communities' well-being and local ecologies (Schröder et al., 2019).

Minga researchers caution that this divergence seems to be proof of colonial thinking at work. Indeed, even if unconsciously, university-led knowledge about CE, which emphasises (waste) management and technological improvement, continues. This means that this GN ontology will further contribute to disembodying the concept of circularity from concrete people and territories. Moreover, it hinders the humble recognition that is needed to relearn those forms of circularity that marginalised people keep on doing even if in precarious conditions (Gonçalves, Sousa and D'Alisa, 2023).

In Lowerland, a farm in the middle of South Africa, the entrepreneurs set out to replace industrial patterns of agriculture based on chemical inputs with an approach to regenerative agriculture which embraces organic practices. Here there was no *a priori* decision to establish a circular economy, but the necessity to feed the soil required cropping rotation, the prudent use of waste, and the incorporation of animals into the arable spaces. Further, the requirement to learn new ways of working, and the gradual forging of a culture of learning, as farm workers and owners alike explored organic agricultural process, had an unplanned effect. This shared learning activity bridges social divides that have been inscribed over decades.

There were immediate benefits in social relations within the farm workforce; circularity of the production process catalysed social shifts. The need to go beyond conventional routes to market moreover prompted partnerships with other enterprises, and new enterprise formation, in creation of a mutually beneficial value chain. An unforeseen core competence became ecosystem building and management. Within a period of five years, we see the emergence of a circular economy around Lowerland, which both stimulates *social* transformation and is dependent upon it (Sewchurran, Andersson, and Davids, 2023). In many respects an imagination of societal enterprise is kindled, with collaboration of many enterprises across a landscape, with shared commitment to the common good.

8.1.2 Diversity of pathways

It is perhaps the wider horizon of the southern imagination that brings such crucial difference in paths of social transformation suggested by the concept of circular economy. In the limited number of cases studied so far, two perspectives help us to understand what is producing the differences in the depth of social transformation being achieved in this pursuit of circular economies.

The first perspective relates to how leadership is understood and practiced. The second perspective relates to an understanding of organising that emerges from within the circular economy process.
The circular economy emanating in the GN seems to focus on the bounded firm and an immediate production process that values leadership as a role responsibility that is placed at the apex, or origin of the flow. In this context, organising is appreciated as bounded by enterprise concerns in its interactions in the market, with clear differences between management, those within the organisation offering their labour, those owing the capital investment, and those identified as recipients of value. This is the quotidian practice of our time and there is reassurance in its very familiarity. While this conception of leadership from a single source may give the impression of steadiness, it may very easily keep people participating in the process without growing their imagination of other potentialities of the circular economy, and without them taking discretionary initiative.
In contrast, the circular economy of the GS with its unbounded horizon seems to appreciate that leadership is both a role responsibility and a collaborative process. The Lowerland and Morocco cases in the Just2CE project show this in the ways the particular organisations define their goals. The Lowerland case shows this in practice too. The case from Zimbabwe shows an acute awareness from participants that the projects potential will be unfulfilled unless a collaborative process is matured to grow reciprocity, solidarity, and ecological care, by seeing leadership as both role as well as collaborative process. There is appreciation that leadership is brought and produced by more than a single individual. Leadership potential is imagined as ongoing changes in potential directionality or momentum by *the whole social grouping*; keeping coherence in the circular economy is then a leadership function that is not solely dictated by a founder or catalyst. One could say that the coherence of the emergence of the circular economy is anchored by the founders' vision but also depends on the motivations and actions of participating members.
In fact, where circular economies concerned with the wider ecology of organization survive and thrive it seems this is because of the efforts of all participating members, and this emergence continues through shared learning. The cases from South Africa, Morocco and Zimbabwe show an understanding of this. The energising influence of the participating members is an important resource to develop and nurture. The Lowerland case study illustrates this more intentionally. The founder highlights the importance of inducting any new participating members, personally, into the story and the whole dream of Lowerland. During this process he invites new members to join in the project of reinventing farming and encourages initiative and project ideas. The interviewees confirmed the impact of this invitation. Several of them, formally workers on the farm, described personal projects that they have been thinking through with the owner which in some cases had already been implemented within the Lowerland ecosystem. One interviewee explained the venture that she was passionate to get going which involved milking the goats used in mob grazing and using the goat milk in cosmetic products for skin care. Another worker shared his interest in keeping a flock of chickens on the farm that grazed the fields after the animals had mob grazed. Yet another interviewee talked about his passion for merino sheep, which he had asked to be brought to the farm to be sheered for their wool, and his excitement about the quality of the wool from sheep that are now grazed on organic fields.
In the Portuguese case we observe a similar phenomenon of leadership from Minga's founder, with growing numbers of people involved and learning together, the mobilization of many small enterprises, and a shared commitment to a circular economy that has brought transformation to the rural landscape (Gonçalves, Sousa and D'Alisa, 2023).
Far from a mechanical application of the concept of circular economy we see then in each case ongoing acts of transformation at individual and collective levels to grow the circularity and its potential transformation. This is

marked by a particular kind of leadership practice; commonly referred to as collective leadership or leadership as practice (L-A-P) (Raelin, 2016). Leading from within these inter-subjective relationships requires a sharing of values and perspectives, and encouragement for the ongoing forging of a pact for transformation.

These vignettes make it possible to see that the circular economies of the unbounded enterprise, as shown in these examples from the GS, depend on an inclusive collaborative leadership process. Whilst there is a catalysing leadership influence there is also emerging leadership participation that is co-developed continually. The catalysing leadership influence needs to establish coherence - for instance, the owner at Lowerland frequently highlighted the need to balance the long and the short term, concepts that define good business principles within the entrepreneurial space (Sewchurran, Dekker & McDonogh, 2019). Through this mechanism an awareness of living emergence became evident. This resembles the functioning and design of a complex adaptive system that is emerging in newer circularity potential.

The second perspective to explore the differences between circular economy practices relates to how organising is accomplished. In the GS there is an easy appreciation that organising processes and practices need to inculcate an appreciation of being within a system. In both the Lowerland and Minga cases there is evidence of organising practices being co-developed to grow the connection between participants and their awareness of the wider systems functioning and how this depends on their own involvement. The processes within these cases show that they are designed to engage the participants in dialogical relations with other members of the ecosystem, and this helps to keep the emerging circular economy thriving and coherent. Both cases show organisational ecosystem features and it is useful then to gain insights from the literature on this topic.

8.2 Literature Perspectives on Ecosystems

Early organisation studies literature describes ecosystems as a "*community of organizations, institutions, and individuals that impact the enterprise and the enterprise's customers and supplies*" (Teece, 2007, p. 1325). Here, the ecosystem is conceived as an economic community of interacting actors that all affect each other through their activities which show a consideration of all relevant actors beyond their industry boundaries. In this sense, the ecosystem sensibility represents a wider environment that firms must monitor and react to, to build sustainable competitive advantage (Teece, 2007). This initial definition of an ecosystem has evolved.

Adner more recently offers a more encompassing definition of ecosystems as: "*the alignment structure of the multilateral set of partners that need to interact for a focal value proposition*" (Adner 2016, p. 23). This definition combines four constructs that coalesce to reinforce the essence of an ecosystem. "*Alignment structure*" refers to the extent and means through which mutual agreement exists among the members of the ecosystem. "*Multilateral*" implies a multiplicity of partners with an emphasis on non-decomposable relationships. "*Set of partners*" refer to participative actors who have a joint goal of value creation. Finally, "*focal value proposition*" refers to the value proposition which remains the foundation of the ecosystem.

A succinct definition of an ecosystem is suggested by Jacobides, Cennamo, & Gawer (2018) who define it as" *a set of actors with varying degrees of multi-lateral, non-generic complementarities that are not fully hierarchically controlled.*" (Jacobides et al. 2018, p. 16). This definition highlights the crucial attributes of an ecosystem. First, "*multi-lateral, non-generic complementarities*" are either unique complementarities (which essentially lead to some degree of co-specialization), or super modular complementarities (often found in complements-in-use). Secondly, ecosystems are not unilaterally, hierarchically controlled. They are distinct in that their members all retain residual control and claims over their assets: no one party can unilaterally set the terms for, e.g., prices and quantities, or standards. Furthermore, ecosystems need to be both *de jure* and *de facto* run with independent decision-making processes i.e.. autonomous systems. In addition, the ("multi-lateral") complementarities exist at the level of the sets of roles (Adner, 2016) that link the different parties together—e.g., hub(s), suppliers, or different types of complementors.

These definitions highlight that several conditions are necessary for ecosystems to emerge. M**odularity** and the coexistence of different types of **complementarities** are required to enable the structure of an ecosystem. Furthermore, improved ecosystem formation and structure and the way firms influence them is dependent on examining the nature, **directionality,** and intensity of these complementarities. With these attributes in place, the result is likely a distinct increase in **value creation** (Jacobides et al., 2018). Ecosystems now offer possible forms of organising economic activities, linked by specific complementarities, and these complementarities create the distinction between the structures of ecosystems and the strategically dynamic behaviours that they give rise to. These distinct features of organising collaboration require leadership different to the heroic, power-over models. Whilst little is said about ecosystem leadership it seems logical that a more inclusive ethos of creating power-with others is likely to be required (Goshalia, McDonogh, Mhlanga, & Sewchurran, 2021) The ecosystem development that has paralleled Lowerland's transformation of agricultural practice manifests this leadership philosophy.

These insights from the theoretical development of ecosystem organising are useful to explain the dynamics at play in the functioning of circular economy ecosystems in the cases of Minga and Lowerland. They show why hierarchical control is avoided. They also show that there is ongoing need to align and structure value creation to balance self and collective interest, to maintain complementariness and modularity. Whilst helpful they don't tell the full story of how the social transformation arises. Could internal practice dynamics provide a part of this story?

8.2.1 Internal practice for ecosystems development

Looking more deeply at the examples from Minga and Lowerland, we see an implicit philosophical orientation playing out through the design and practice that implies a valuing of the intersubjective, inter-relating practices. It seems that once there is an appreciation of the enterprise within a broader organizational ecology, and discovery of the circular economy practices that produce social transformation, then this means self-prescribing to the universal principles of reciprocity. Participants in both cases are made increasingly more aware of how 'my' being and 'your' being are collectively creating our humanity as moral beings. In the phrasing of the Vietnamese founder of Engaged Buddhism, Thich Nnat Hahn, there grows an awareness of Interbeing (n.d.). There are examples in the Lowerland case where trainees went back to their tertiary organisations to renegotiate their field assignments to focus on projects that related to work at Lowerland that was not covered in their curricula. Continuing this stance, the founder asked everyone to be their own manager, to get involved in creating new knowledge about farming and to find their passion.

Co-producing circularity – both in terms of directionality and in maintaining momentum - is to lead from within, rather than from above. As Reuel Khoza (2012, p. 65) puts it in recollecting about Nelson Mandela's style, it is to *"plumb the heart for its own motivations"*, and in so doing build *"consonance with [..] desires and disappointments [of self and others], respecting their human worth"* whilst holding oneself and others accountable to, and responsible for, the highest moral possibility. The founders of Lowerland both mention growing up with an acute awareness of their privilege and being uncomfortable with this. This discomfort is channelled into growing themselves in their efforts to be more involved in growing others.

8.2.2 Do these differences matter?

Are these differences eclectic, hard to replicate, or unnecessarily complex? When compared to key emerging trends in Organization Studies and Leadership Studies the design principles for initiating circular economy organising in the GS seem to align with the key emerging thrusts of these disciplines.

In leadership studies there is a distinct call to enlarge understanding of leadership to shift focus from the heroic acts of an individual to an appreciation of the collaborative process that needs to be fostered for leadership to emerge as a process of co-developing of power to foster directionality (Grint, Jones, & Holt, 2016; J. A. Raelin, 2020; Sewchurran, 2022; Sewchurran, Davids, McDonogh, & Meyer, 2022).

Similarly in organization studies, numerous schools start to appreciate organisation as an ongoing accomplishment arising from commitments human beings make to themselves and others to drive for particular goals (Shotter, 2006, 2008, 2016). It would seem that these two trends, which are commonly referred to as the '*process*' and '*practice*' turn, are being pursued in a practical way in the circular economy projects we have referred to here, albeit out of necessity to achieve a 'just' social transformation.

These cases show the benefits that accrue to the participants as they participate in the organising practices. They show how valuing the socio-material entwinement helps with achieving improvements in purposefulness, inclusiveness, and social solidarity. These benefits that appear to be fundamental to circular economy projects in the GS shed light on the potential value that arises from adopting an understanding of organising that deals more judiciously with the complexity in human systems.

Questions could rightly be asked if this is possible on scale. These questions about scale however need to be balanced with the expressed need for a 'just' transition; as well as an understanding of the early stages of innovation we find ourselves in to produce organizational forms that embody a practice of leadership that allows joint flourishing. The wider need for such organising practices and leadership is highlighted by Leinwand, Mani, & Sheppard (2022) when they make the crucial observation from their fieldwork that organisations world-over seem to lack leadership that is able to use personal transformation processes to drive organisational transformation. They observe that organisations need leadership that is able to drive organisations to commit to their most noble purposes. Is this not what a 'just-transition' is beckoning us to do?

Said differently, if we desire a just transition to a circular economy then the organising process has to be more fully appreciated for the ways it impacts the inter-subjective worlds of the human participants. The creation of organising patterns seem to emerge when there is due care given to the ways the inter-subjective worlds are engaged. This attention to the ongoing accomplishment of organising is very likely the key to producing momentum and directionality in the social systems of the cases discussed.

Circular economy projects in the GN seem by comparison to have less concern with the organising practices and leadership ethos needed to produce the solidarity and resilience in human systems which circular economy organising practices of the south show. In summary whilst it might be achievable to create a circular economy based on a blueprint, such a circular economy might not have the resilience and the social solidarity to adapt to new needs and unforeseen circumstances. A bigger set of questions can also be asked: Who benefits? Who loses? Or who is served ultimately? If these questions are not kept alive in the inter-subjective worlds, deep social transformation will be limited in achievement and aspiration.

8.3 Conclusion: CE as a transformative concept

There is a very practical consequence of this insight about how the conception of a circular economy can catalyse transformative action to social process in its application. This is not moreover restricted to the geographical territories of the GS. Calls to circularity are implicit in the reciprocity that is a foundation of African philosophy which is variously labelled *Ma'at/Ubuntu/Botho,* as well as the *buen vivir* of Latin American indigenous traditions, and in fact in indigenous traditions from other parts of the world. This can galvanise northern imaginations just as it does those of people from the GS. There may indeed be a greater receptiveness now to insights from indigenous traditions. The experience of COVID19 pandemic has disrupted previous patterns of international business and brought awareness of the fragility of supply chains while the climate crisis has challenged long held certainties. Perhaps there is more openness now to lessons derived from ancient wisdom.

Within southern Africa the concept of circular economy has immediate resonance for social and economic transformation, and specifically informs methodologies for developmental practice. An imperative for circularity emerges from the shared recognition about land dispossession and the destruction of the peasantry, and the daily reality of hunger that has increased with the failures in long-distance supply chains. Self-transformation in those most involved in the process brings proposals about systemic transformation across that landscape. This circularity imperative does not however mean that the final destination is known or fixed, rather that there is confidence in the inner logic of a circular economy in its widest sense and an embrace of the whole ecosystem.

It is not only individual communities that draw on conceptions of a circular economy. The Alliance for Food Sovereignty in Africa mobilises members involved in regenerative agriculture across southern Africa drawing on its precepts (https://afsafrica.org/). The Southern African Food Systems Transformation Alliance has brought together key players in the private sector and the broader civil domain who commit to the ambition of at least 80% local sourcing of food and supply chain ingredients by 2033; meaning the circulation in southern Africa of some $2bn annually that presently leaves the region. Central to this is an increase in numbers and scaling up of productivity of new and emerging farmers, bringing about 72,000 new jobs. (https://www.idhsustainabletrade.com/southern-africa-food-systems-alliance/). Local sourcing of food and supply chain ingredients leads to a reduction of unemployment and strengthening of local economies which in turn provide markets for neighbouring producers; there is thus enhanced circularity across organizational ecosystems. Each of these initiatives, and others that are similar, have involved deep reflection and the forging of common purpose; each of them has only been possible through a certain style of work, where leadership is appreciated as process emerging from the flow of practice. There is no blueprint to adopt; the path must be made by walking and engaging the aspirations of those participating. The continual emergence is the path and one of the prominent inter-subjective experiences of the path is an ongoing leveraging of the tensions of ideals of self and other.

Looking at these examples we see that there is a diversity of paths towards social transformation, a journey that needs to be kept alive in both practical aims and aspiration. This space of inquiry is healthiest when it is collaborative. To keep coherent directionality requires the growth of compassion, trust, and constant adjustment of beliefs with a deepening awareness of values cherished. This image of social transformation requires a circular economy construct that is *emergent* rather than a static, completely planned phenomenon, since social transformation is a journey that needs both ideals and pragmatism. In the words of the Lowerland founder there is a continual need to balance the aim for the long term with the needs of the short-term.

Conceptions of circularity are about a living dynamic, emerging ecosystem, undergoing subtle changes in directionality of purpose, meanings, and beliefs. This happens at the levels of self and at the level of concerns for the well-being of others, for all life. A philosophical grounding is as important in this as is an economic literacy, and in southern settings there is a blossoming of confidence in the indigenous knowledges that embrace circularity.

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Chapter 9. Decolonizing CE: some reflections on theory and praxis from the JUST2CE experience

Emanuela Girei, Andrea Jimenez, Tess Doezema, Ben Purvis, Maddalena Ripa, Joana Sousa, Marco Veronese Passerella, Mario Pansera, Andrea Genovese

Abstract

In this chapter, we share our reflections on how, within the JUST2CE project, we have engaged with postcolonial and decolonial debates and how they have contributed to shaping our epistemological and methodological approach. The chapter begins by highlighting some shared critiques emerging from postcolonial and decolonial debates on one side and critical perspectives on CE on the other, specifically focusing on the enduring dominance of Eurocentric perspectives and the simultaneous marginalisation of alternatives (section 9.1). It continues by exploring how these critiques informed our methodological approach and efforts to embed decolonial lenses within JUS2CE (section 9.2), and the work undertaken in the first twelve months of the project (section 9.3).

Keywords: Decolonisation, Political Reflexivity, Western, Eurocentrism.

This chapter describes our efforts to embrace a shared decolonial perspective for JUST2CE, focusing on the work done in the first twelve months of the project. It discusses the challenges and opportunities posed by the process of decolonising CE research and looks ahead to future work.

9.1 Introduction

Recent critiques of CE unveil and contest its 'eco-modernist' agenda (Genovese & Pansera, 2021), and the underpinning primacy attributed to capitalism's expansion and economic growth. It is argued that CE, rather than altering existing economic dynamics and priorities, enhances market capitalism by instrumentally embracing green ideals that further facilitate and promote consumption and production, and, ultimately, environmental degradation (Valenzuela and Bohm, 2017). Importantly, several scholars have drawn attention to the prevailing technocratic conceptualization of CE (Pansera et al., 2021), which manifests itself in a strong faith in science and technology, in the passive compliant role attributed to citizens, and in the neglect of social and cultural issues (Mies and Gold, 2022). In fact, while CE is frequently depicted as an interdisciplinary field, the literature reveals that it is primarily defined by technocratic discussions in which science, technology, and innovation all play a crucial role in how CE is conceptualized and planned (Pansera et al. 2021). This techno-managerial dominance typically presents science, technology, and innovation as neutral dimensions that contribute to progress and development. Approaching CE research and policy in this way embeds and reproduces western-centric perspectives (albeit elevated as universal), whose limitations have been widely acknowledged in various disciplines, from development studies (Mignolo & Walsh, 2018), critical management and organisational studies (Girei, 2017), and beyond (Connell 2007).

Seeking methods to disrupt this pattern, we proposed a set of interventions to bring an explicitly decolonial lens to our CE research interventions in the JUST2CE project. In this chapter, with a decolonial lens, we specifically focus on epistemic decolonisation yet acknowledge the risks implied in the understanding colonisation disentangled from material implications, such as. control of land and resources (Abdelnour, 2022). Yet, we see epistemic decolonisation as a necessary step for developing ways of knowledge production that unsettle the Eurocentric gaze and contribute disrupting existing broader colonial legacies.

This chapter examines the interventions and practices we introduced in the first year of the project, explicating key findings and challenges that emerged in the process. We offer these reflections as evidence of the importance of including decolonial lenses in CE knowledge production in particular, and as a set of guiding observations for those who might seek to implement a similar process in other CE knowledge-production efforts. In the following, we first elaborate the relevance of decolonial lenses, establishing the basis of our research interventions. Subsequently, in section 10.3 we explore what was done in the initial year of the project in relation to our commitment to embed decolonial lenses. Finally, in section 10.4 we present how this commitment has been understood and implemented in the planning of the different work packages.

9.2 A Decolonial Lens on Knowledge Production

Decolonization recognizes that the racial, political, and social hierarchical orders of colonialism are largely still in existence, having been absorbed into successive social orders in the post-colonial world (Quijano, 2000; Bhopal, 2018). It refers to continuities of colonial practices and imaginations across space and time on a global scale, and is based in an understanding of European colonialism as continuing to shape global economic, political and social structures and relations (Maldonado-Torres, 2011. Decolonial scholars have long debated and examined the inequalities that shape knowledge (Mbembe, 2016), acknowledging that science is predominantly dominated by western and Eurocentric cultures, values, and ways of seeing, thus it is always partial (Hlabangane, 2021). They have also argued that this epistemic debate is critical for addressing social inequalities and understanding historical injustices (Escobar, 2016). Drawing on these debates, this section introduces a review of epistemic decolonization, which informed our approach to decoloniality in the JUST2CE project.

Eurocentrism has dominated knowledge production as "[...] an epistemic phenomenon that received its name from the territorial location of actors, languages, and institutions that managed to project as universal their own world sense and worldviews" (Mignolo 2018, 194). One of the distinguishing features of Eurocentrism is that, despite being written from specific geographical locations, its texts, theories, and approaches frequently claim to speak in universal terms (Connell 2007). The texts' and authors' locations are frequently kept hidden, as any explicit recognition would call into question the texts' assumed universal applicability (Connell 2007). Moreover, these European intellectual and economic traditions are elevated to a superior status, a universal model by which to assess, compare and produce knowledge about the rest of the world (Amin, 2004. Importantly, this universal status also means they are mobilized as if they are neutral and do not come with ideological baggage.

All this does not imply that all knowledge produced in Europe has these characteristics, as there are non-hegemonic western forms of knowledge as well (Liboiron, 2021). Instead, it refers to a form of knowledge that is typically rationalist and secular, emphasizing the significance of science, economics, and technology (Connell, 2007). What this means is that other forms of knowledge are subordinated to this form of dominant Eurocentric knowledge (Tuhiwai-Smith, 2012). And with this epistemic subordination, comes the subordination of peoples, and cultures. As the feminist philosopher of science Sandra Harding puts it, Eurocentrism implies "the world-wide dominance of only one ethnoscience, and one that inherently legitimates—perhaps even requires—an imperialism against other scientific traditions, other cultures, other peoples and nature itself" (Harding, 1992, 311).

Moreover, eurocentrism has resulted in many of the global challenges we face today (Escobar 2017). For example, by destroying most communal and place-based forms of relationality, while prioritizing individualism; by adopting an ethos of human mastery over nature; and by positioning the economy as separate from social and ecological life, thereby situating the economy as a priority above all else. One of its key underpinning assumptions is the conflation of modernity with development and its attached hierarchization of the plurality of economic, political and cultural systems existing across the globe, which continue to position the GS as lagging behind (Mignolo, 2018).

Eurocentrism also reinforces relationships of inclusion and exclusion. Other epistemologies, such as those with holistic perspectives, may not align with the available methodological instruments of western epistemology (Escobar, 2016). Sociologist Patricia Hill Collins (2019) asserts that western epistemological and methodological tools are incapable of making sense of holistic entities. Because of this, those perspectives remain absent from dominant west-centric understandings of the world, and when advanced they are treated as particular and subjective. Meanwhile, empirical reality may diverge significantly from the world as described with the required level of theoretical abstraction to constitute legitimate scientific knowledge. In other words, what cannot be comprehended with the criteria of western science is rendered invisible due to this epistemological dominance. This understanding compels us to pay close attention to other epistemic forms, while underlining the importance of paying attention to the injustices that silence and deprioritize diverse ways of knowing.

Cultures and societies are not static, but rather dynamic and diverse within themselves. Accordingly, knowledge is built on a variety of ontological commitments, epistemic configurations, and practices of being, knowing, and doing (Escobar 2018). It is relational, contextual, practice-based, and lived in (Blaser and de la Cadena, 2018). A pluralistic approach acknowledges and embraces this multiplicity and recognizes that knowledge is produced from various locations, thus bringing it closer to popular struggles and daily life.

The notion of Eurocentrism is relevant because it invites us to scrutinize the embeddedness of mainstream CE literature in Eurocentric knowledge, especially considering its previously noted technocratic and market-driven dimensions. Importantly, it is also grounded in the modernizing project, insofar as CE is progressively taking center stage in debates and discourses on sustainable development, and it is represented as a universal new path toward progress, able to answer the need of the market and those of the environment. In the next section, we describe strategies and actions shared across the JUST2CE project, which we undertook in our efforts to make visible and disrupt entrenched patterns of Eurocentrism, embed reflexivity, and introduce diverse knowledge production into our collective knowledge production practices.

9.3 Embedding decolonial lenses in JUST2CE

9.3.1 Project Level

JUST2CE's research network is highly diverse with regard to academic backgrounds and familiarity with debates on decolonization. It was thus important to start by building some common understandings around what decolonisation might mean for the JUST2CE project and inquire how we could contribute to this collective effort. Our exploration of these questions across the network were informed by action research methodologies. These approaches aim "to bring together theory, method, and practice as people work collaboratively towards practical outcomes and new forms of understanding" (Frisby, Maguire et al., 2009:14). We aimed to start a process of learning and reflecting on our actions and choices so as to a) identify strategies to enhance the network's engagement with decolonization, and b) create a safe space where challenges and dilemmas could be explored, including those arising from our diverse background and positionalities.

At the project level, there were three key events/actions aimed at creating a common base across the project, including: a session on decolonization at the kick-off meeting (September 2021), a session on decolonization at the annual consortium meeting (July 2022), and inclusion of decolonization as an item for discussion in various progress meetings. More specifically, in the various work package meetings (particularly in WP2, on case studies), we endeavoured to systematically include reflections on decolonization, which implied questioning taken for granted assumptions regarding our own research practices (see section 3). In addition, before and after these meetings, documents were shared within the network, summarizing key points for discussions. Sharing these documents provided the opportunity for all involved to add their comments and reflections, which were further discussed during meetings or via emails. Furthermore, decolonization was included in other project-level events. For instance, the two-day internal training that took place in October 2021, which involved all researchers and partners, and included two sessions on decolonization in which we had the opportunity to further reflect on and discuss the relevance of decolonial thought within the JUST2CE project.

The first session on decolonization at the kick-off meeting (September 2021) sought to open a discussion on how decolonization was understood within the project network, in order to begin to establish a common understanding across the different work packages. During this initial session, we started to identify some key issues around which to create our collective and individual reflections on decolonizing JUST2CE. We focused on four issues in particular: knowledge/local knowledge, research design, the role of researchers, and reflexivity. These four issues, which we discuss in section 10.3.2 below, should be understood as 'sensitizing' nodes around which we problematize the western scientific canon and start re-conceptualizing crucial dimensions of our research project. We chose these four issues because they are cross-cutting issues addressed in the literature on decolonization, and because they all touch upon key dimensions of research processes, which are familiar to different extents to all researchers involved in JUST2CE.

During the annual consortium meeting (July 2022), we continued our collective reflection by focusing on four different sensitizing 'concepts', namely coloniality, coloniality of power, coloniality of knowledge, and coloniality of being (Maldonado-Torres, 2007, Ndlovu-Gatsheni , 2013). Ndlovu-Gatsheni (2015) suggests seeing coloniality as an "octopus constituted by hierarchies of domination, control, and exploitation" (p. 487), which defines identities (coloniality of being), knowledge (coloniality of knowledge) and current global power structures (coloniality of power). We chose these concepts as they allowed us to advance the collective reflection, we started a few months earlier. While at the kick-off meeting in September 2021, we aimed to create a basis to problematize some well-established rules of research processes, in this second collective workshop, the aim was to deepen our individual and collective understanding of what decolonization might mean in our project.

9.3.2 Kick-off meeting

Problematizing local knowledge, embracing radical contextuality

Our intervention at the kick-off meeting aimed to explore what decolonial knowledge might be, what its characteristics are, and what kind of knowledge might contribute to contrast and subvert the western-centric knowledge informing dominant debates on CE. We discussed the debate over a shift in emphasis toward local knowledge and the associated risks of romanticization (Jackson 2013), exoticization (Okere, 2005), and simplistic framings of this move as a solution to western dominance (Briggs, 2013). Our intention was to recognize the importance of valuing epistemologies other than the western canon, giving voice to local communities, and producing locally relevant knowledge. At the same time, we recognize the complexities of knowledge production and legitimization dynamics and practices outside of the western world (Harding 2011). We believe it is critical to investigate the connections between local and western knowledge systems, taking into account how they are shaped by existing asymmetries.

We expanded on the invitation of Okere et al. (2005) to understand local knowledge as the result of "mutual push and pull between the people and the potential in their history and life-world, task-related networks and living communities" (2005:3). Thus, for us, local knowledge is contextual, constantly negotiated, and inextricably shaped by contestations, power asymmetries, and dynamics. In this regard, "radical contextuality" (Escobar, 2008) encourages a deeper embodiment and embedding of research contexts (human, cultural, symbolic, historical, economic, etc.). This requires a radical approach to research that engages deeply with participants and local communities, drawing on their contexts rather than familiar perspectives and standards (Dyll 2020; Keeyaa 2020). Engaging with local contexts would have three benefits: 1) it would broaden epistemological and ontological perspectives; 2) it would supersede the comparative lens that often underpins research about the GS (Mamdani, 2004); and 3) it could allow for greater local impact so that research is not produced merely for academic circles/purposes (Keane, Khupe, and Seehawer 2017).

Starting with this context, a number of questions were raised during the kick-off meeting: What role can local knowledge play in a project like JUST2CE, which already has clear validation mechanisms shaped by Eurocentric interests, values, and epistemological assumptions? How can we create synergies between different knowledge systems and our diverse backgrounds? What strategies can we employ to connect micro and macro lenses in order to engage with the uniqueness of our research contexts without ignoring overarching geopolitical-economic patterns and dynamics? What are the risks of radical contextuality for JUST2CE?

Liberating research design: moving toward an open-ended approach

Another topic we discussed at the kick-off meeting was what kind of overarching research design could help us achieve our goal of decolonization. We considered how the dominant linear, deterministic understanding of the research process, as well as the associated neglect of the role that indeterminacy and contingency play in social (research) processes, might undermine meaningful engagement with the contexts in which the research is conducted. Recognizing the constraints imposed by following a structured research design, as well as calls for epistemic de-linking from the web of imperial knowledge (Mignolo, 2009), we proposed that efforts to decolonize knowledge and research would benefit from a stronger orientation toward an open-ended approach (Girei and Natukunda, 2021). This entails focusing on the 'becoming' rather than the state of 'being' of social formations and actors, as well as the interconnections and overlap among social actors, disciplines, and spaces (Alff and Hornidge, 2019:1148).

Based on this context, we identified the following questions as starting points for our individual and collective reflections: to what extent and how can we 'liberate' our research approach while remaining compliant with the funder's contractual obligations? What are the constraints we anticipate, and what steps can we take to reduce them? What are the advantages and disadvantages of adopting open-ended orientations?

Towards co-production in research roles

We propose considering a co-production orientation as an epistemological and ethical stance that contributes to not only disrupting the pattern of silencing and misrepresentation of southern voices and perspectives, but also asserting human beings' right to shape knowledge about themselves, their communities, and their organisations (Reason, 2001). This necessitates an active reconfiguration of the asymmetries that frequently shape South/North research collaborations (Parker and Kingori, 2016; Carbonnier and Kontinen, 2015), in which high-income countries continue to be the primary beneficiaries of international research collaborations, particularly in terms of authorship, international profile, and influence in the research process.

In this sense, Erdal et al. (2015) invite us to consider inequalities in international research as an inherent and rooted dimension that requires constant analysis and reflection, as well as corollary conscious choices about our practises and commitments—at the micro and macro levels, at home and abroad, with our international partners and with our colleagues and managers in our own institutions. In this regard, the JUST2CE project, which brings together a diverse group of researchers and institutions from Europe and Africa, is an ideal setting for identifying and implementing more just and equal collaboration models.

By collectively reflecting on this foundation, we identified a number of questions that we addressed in planning the work of the different work packages of JUST2CE. The questions we identified are the following: What challenges do we anticipate in establishing and maintaining equal and just relationships among researchers and participants? What strategies can we use to move toward co-production, and how can we support one another in this process of learning? What actions must be taken to create and nurture a culture in which we are all responsible, albeit for different reasons and from different positions, to challenge existing asymmetries and build more just international research collaborations?

Participatory and self-reflective practices

Our understanding of how we as researchers approach our engagement in the research process is not only intellectual, but also emotional, ethical, and political in nature. This choice is based on an epistemological perspective that rejects the demands for "suprapolitical objectivity" (Said, 2003), recognizing that knowledge must be entwined with ethical and political threads. Apolitical abstraction and neutrality may prevent researchers from appreciating the broader meanings and consequences of their work and the possibility of causing harm and further naturalising and legitimising existing inequalities (Abdelnour, 2021). It follows that researchers must constantly investigate who is served by the choice of specific research practices and interventions (Tuhiwai-Smith, 1999). Furthermore, researchers should consider and make explicit which worldviews they espouse, as well as their impact on the lives of those involved in the research. In this sense, self-reflexive practice for us entails a critical examination of the assumptions, values, and interests that underpin and guide our actions and thoughts, demanding not only self-awareness on the part of the researcher, but also the willingness to question our methods and assumptions (Alvesson and Deetz 2000). In the sociology of technology and responsible innovation, this is directly related to the concept of reflexivity and second-order reflexivity (Stilgoe et al 2013).

Our understanding of reflexivity is based on Abdelnour and Moghli's (2021) concept of 'political reflexivity', which invites researchers to "account for their positionality and privilege in relation to power disparities, seek out and centre marginalised voices in their work, and, where possible, subvert those structures that do the marginalising" (p.2). In this sense, reflexivity serves the emancipatory goals of liberation and reparations. Building on this foundation, we began to address the following questions in the context of JUST2CE: how can we engage in self-reflective practice individually and collectively? How can we hold this process accountable and transparent while also acknowledging boundaries and the limits of what can be known/said/shared? Who is our project serving, who will benefit from it, and how will we deal with competing interests? How do we seek to challenge the dynamics and structures of epistemic oppression, and what role do we play in reparation and liberation?

In the previous pages, we described what we did at the kick-off meeting in our effort to embed a similar lens in the various segments of research included in the JUST2CE project, committed to revealing and contrasting the Eurocentric gaze in our own work. We identified several questions related to four different aspects of our research (knowledge/local knowledge, research design, the role of researchers, and reflexivity). We saw these four issues as 'sensitising' nodes around which we problematise the western scientific canon and start re-conceptualising crucial dimensions of our research project

9.3.3 Consortium meeting

At the consortium meeting, we decided to build on the results of our previous interventions, and deepen our collective reflection on decolonising JUST2CE by exploring the notion of coloniality, and its ramifications as *coloniality of power*, *coloniality of knowledge*, and *coloniality of being*. We started the session by providing some definitions of these terms, and then we continued first with an individual reflection, followed by a team reflection/discussion and finally with a plenary reflection/discussion. We started by suggesting decolonisation as an engagement with how coloniality shapes past, present and future histories and possibilities, with the aim of contributing, through JUST2CE, to confronting, contesting and subverting.

As part of this intervention, we explored specific ramifications of Global coloniality, such as the coloniality of power, coloniality of knowledge and coloniality of being (Ndlovu-Gatsheni, 2013; see also Jimenez et al., 2022), reflecting more broadly on the legacies of colonialism in our academic background, the socio-economic-political contexts we inhabit and in our identities. We reflected on how the notion of global coloniality relates to our project at different levels, starting with the fact that it is funded by the European Union. One of the issues the group discussed was whether our complicity with the European Union fundamentally jeopardises any attempt to decolonise our research (see also Vela Almeida et al., 2023). More specifically, we critically interrogated the political meaningfulness and intellectual honesty of engaging with decolonisation from within a project such as JUST2CE, which already has clear validation mechanisms shaped by Eurocentric interests, values and epistemological assumptions. We inquired what constraints those validation mechanisms pose to our commitment to decolonised approaches to knowledge production.

However, we also acknowledged that our research, because of its focus on justice and equity, cannot eschew engaging in decolonial and postcolonial debates. For instance, the consortium meeting was held in Greece, and to travel to and attend it was certainly more troublesome for our African colleagues. In fact, despite a long preparation to ensure their participation, none of them could attend the meeting. So far, we have understood such engagement mainly as individual and collective reflexive practices, which do not and cannot have 'deliverables', because they are ongoing, open-ended and focused on problematisation rather than problem-solving. Such an engagement, however, also represented an opportunity to reflect on how global coloniality shapes relations and arrangements within our research network, and thus directly informs our modes of collaboration and outputs. This includes all of the project's deliverables, especially how we collectively approach their design and review.

In this section, drawing on the extant literature and initial collective reflections, we have drawn out the key dimensions that we believe are relevant to our commitment to embed decolonial lenses in JUST2CE – local knowledge, research design, the role of researchers, and reflexivity. However, the project develops through seven work packages, each of them with distinctive features, including different research teams and different research contexts, across which these dimensions cut. In the following sections, we analyse more specifically how these dimensions are relevant to the different work packages, what challenges we envisage in each of them, and how they can offer a distinctive contribution to developing a decolonial research process.

More broadly, as we shall see in the following pages, our engagement with decolonisation, meant that we agreed to scrutinize, across all work packages, our practices and arrangements with the lenses offered by the notion of global coloniality and its ramifications. We also decided to address within all work packages the questions that emerged at the kick-off meeting. In the following section, we explore in more detail how a selection of the project's work packages engaged with decolonisation in the initial 12 months of the project, briefly outlining how the collective reflexive practice informed the planning of the different work packages.

9.4 Decolonial engagement across the JUST2CE Work Packages

WP2 Enablers and barriers to the transition towards a Circular Economy

WP2 aims at co-creating a multidimensional framework that will be used to identify enablers and barriers to the implementation of just CE practices. Drawing upon empirical and conceptual elements from a variety of fields (such as FEE, PE, EJ, DS), the multidimensional framework (Deliverable 2.1: Ripa et al, 2021) provides an epistemological, theoretical and methodological framework for addressing our key questions, namely: "How do CE transitions unfold across different geographical context[s]? Whose voices and interests are heard and whose voices and interests are neglected? How are costs, benefits and opportunities of CE distributed at different scales and among different social realities?" (p27). These leading questions have guided the analyses of ten organisations in Europe and Africa, which are engaged in different ways in enacting CE concepts and practices, to understand the main barriers and enablers (from both a technological and relational/economic/social points of view) to the implementation of just CE initiatives. The cases are heterogeneous in many respects: representing different geographical contexts (Italy, Spain, Portugal, United Kingdom, Morocco, Ghana, Zimbabwe, South Africa), different supply chains (plastics, food, critical raw materials, etc.), different scales of analysis (from local to global initiatives), and different types of institutional settings (formal/informal).

The insights gathered from the application of the multidimensional framework to the case-studies' analyses were meant to expand our understanding beyond the current narrowly technical focus of most CE knowledge production. The design of the multi-dimensional framework, and the accompanying decision to open it up to research practices and framings that are emergent from collaboration among local research groups, research subjects, and sites was not part of the original project design. Rather, the development of this anti-universalist research framework was informed by our work to decolonize the project, aided by the RRI interventions that were built into the project design from the beginning (discussed more in the following section on WP3). We advance the multi-dimensional framework as one that can help to counter the domination of the mainstream western view of CE over other concepts and ways of knowing. Thus, instead of positioning our knowledge as abstract and universal, we seek to generate diverse cases from diverse knowledge traditions, each of which offers a distinct angle on CE-making and CE potentiality. In this sense, by exploring (circular) practices through a variety of context-specific analytical lenses, and by keeping the epistemological conversation alive throughout the entire duration of the project, we aim to engender engagement across multiple modes of thought and epistemological frameworks.

WP3 Towards a framework for a Responsible Circular Economy

WP3 develops a framework for a 'responsible approach to the CE transition' (D3.2: Celebi et al., 2022), which aims to outline tools and methods oriented to industry, SMEs, cooperatives and community-based initiatives to embed principles of RRI in the design of circular practices. RRI is a science policy concept whose dimensions have significant overlap with the decolonial research approaches, but with a different history and focus. Despite its general appeal to universalist notions of responsibility, RRI has been co-constituted with specifically European imaginations of democracy and citizenship (Frahm et. al. 2021), rendering it inadequate to address the important challenges to the presumed universality of western knowledge and value systems brought to the fore by decolonial debates (Doezema et al 2019).

Thus, although both RRI and decolonial approaches focus on increasing participation, practicing reflexivity, and fostering responsiveness in processes of research and technological development, they take these elements up in distinct ways. We frame RI for the CE as "encouraging alternative thinking and reflection, and the consideration of perspectives from a wide range of stakeholders and contexts" (Purvis et. al. 2023). The overlaps and discontinuities between RRI and decolonial approaches present an opportunity to advance and strengthen both of these approaches in relation to CE research and in the JUST2CE project. An avenue for such collaboration is offered by the elaboration of inclusion and reflexivity, which are important for both RRI and decolonial approaches. Thus, rather than amplifying the voices of those who already overwhelmingly participate in articulating notions of responsibility, good futures and shaping epistemic approaches (predominantly western scientists and technologists situated in elite institutions), decolonial lenses, and in particular the focus on radical contextuality, invite us to interrogate and explore what forms of responsibility might be envisaged from different epistemic perspectives and geographical locations. By doing so, we also aim to contribute to strengthening the institutional recognition of the need for decolonial research practices aimed at opening research design.

More specifically, this project includes a contractual commitment to implementing RRI in our own practice and providing tools to help other CE researchers do so as well, embedding processes of anticipation, inclusion, reflexivity and responsiveness into research design and practice across the work packages. As part of this work, we create formalized spaces of reflexivity across consortium activities, aiming to open up and situate our research design and methods, while remaining responsive to our commitments to research funders. This has already had concrete impacts on the project. One example of this can be seen in the development of the multidimensional framework in WP2, which altered the original format of the case design, as outlined in the project proposal. The inclusion of RRI in the project proposal not only inspired the process by which those changes came about, enabling us to embed decolonial practice into the framework design; but RRI also offered terms in which we could defend those changes in front of those in charge of the funding review process, making our efforts of decolonialization of the WP legible as part of a broader set of practices of responsible research.

WP4 An integrated Decision Support System for Responsible Circular Economy practices

WP4 aims to develop a decision support system that can guide organisations in transitioning towards a CE. It adopts the ambition to develop a tool that addresses the limitations of existing approaches, starting with the neglect of social dimensions, and the predominant role attributed to economic indicators. Decolonial and postcolonial debates invite us to consider some important aspects, raising novel questions that can help us advance the limitations highlighted above. In particular, within the first 12 months of the project, embedding decolonial practices within the design and development of the Decision Support System (DSS) focused on the following three aspects: the use of the tool across different geographical locations, uneven access to data across global contexts, the nature of quantification.

WP4 aims to develop a tool that can be used in different geographical locations, and thus importantly needs to consider how to balance the aim of ensuring the tool's usability across contexts and sectors, with the needed attention to the different socio-cultural-economic contexts. In essence, the initial conceptualisation of the tool, which has been heavily influenced by the perceived desires and priorities of its funder, the European Commission, is deeply embedded in a universalist paradigm. This presents a clear contradiction between the nature of the tool and the ambitions of the project from a decolonial perspective. A departure is thus necessary from a DSS in the traditional sense, as a highly technocratic tool for aiding corporate decision making, to something which at least attempts to onboard the decolonial critiques outlined above.

Linked to this question of universalist use of the tool are more operational questions relating to accessibility, including the language the tool is presented in, and its access offline and from mobile devices. By developing an English language tool largely within European Higher Education institutions, already questions arise relating to its ability to transcend eurocentrism. How too can we take into account the diversity of meanings and priorities existing in the different contexts where the tool will be used? Many of these questions have no clear answers, and limited resources have been allocated within WP4 to address them.

Such a tool as a DSS, requires various data to provide an output to its user. At an early stage it is unclear exactly the nature of data that could be required, and indeed, methodologically there is often a back and forth of deciding which questions to answer dependent on what data is readily available. It is thus necessary to confront issues relating to data coverage disparities between the GN and GS here, and how this has the potential to bias any tool we develop. This is particularly pertinent given the feedback between data availability and the purpose of the tool. The DSS, despite considering a variety of qualitative indicators and dimensions, is predominantly based on quantification practices, whose foundational assumptions (e.g. universality, neutrality, and objectivity) are at the very core of decolonial and postcolonial critiques of western modernity. In this sense, decolonial lenses invite us to relinquish any claim of neutrality, objectivity or universality and rather explore the political and ethical dimensions of quantification and whether and how it is possible to make quantification responsive and sensitive to the contexts where it is employed. These inherent contradictions and how they play out within the context where concrete deliverable are required from the funders of the project will be important to reflect upon.

WP5 Policy models for evaluation and planning of Circular Economy practices

WP5 aims to develop a formal Stock-Flow Consistent Input-Output (SFC-IO) dynamic model (or a suite of such models) to assess a variety of CE policies and practices. In the last decade, several ecological SFC and IO models have been developed (Berg et al. 2015). These models are usually better suited to deal with a variety of economic, environmental, and social variables, compared with the dominant form of neoclassical-like economic models. Nevertheless, such variables usually rely on rather simplistic measurements of impact (e.g., carbon emissions), typically have a limited geographical scope (as most of them are single-country models), and largely ignore social issues beyond basic metrics like employment. Analysing, and computationally modelling the transition towards a CE in the manner proposed within JUST2CE's WP5 requires a deep understanding of production processes, and the resulting trade and financial flows, which usually have idiosyncratic effects on countries, regions and social groups. For this reason, any model should be flexible enough to account for a variety of economic, financial, environmental, institutional and social dimensions. It is important also to reflect on the severe limitations the chosen approach of computational macroeconomic modelling presents for meaningfully embedding a decolonial approach here.

Informed by the critiques of mainstream CE discourse which frame the JUST2CE project, the North-South divide is taken as a core focus of the model, and is intended to be analysed both across different geographical areas, as well as explicitly considering the interaction of each area with the rest of the world. Hereby, the model should produce a method for broadly evaluating unequal exchange, and investigating impacts in the GS of CE practices implemented in the North. Model codes and data are intended to be freely accessible on relevant repositories, allowing other researchers globally to use, question, and/or further develop our work. The modelling team are well aware of the social and political nature of their work, and that the tools used here are not neutral, as they implicitly define the research questions that can be addressed, and the way it is done. Nevertheless, it is important to anticipate how such tools may be utilised for claims of false scientific neutrality. It is for this reason, that it is intended that the WP5 team try to maintain dialogue with colleagues working on other WPs, in which other, mainly qualitative, tools are employed, and in particular pay attention to the discussions relating to RRI from WP3.

9.5 Conclusions

A decolonial lens encourages us to critically examine the power dynamics embedded in CE and to reframe our perspectives by adopting an open-ended, reflexive approach. The process of engaging with decolonial lenses in

JUST2CE is inevitably lengthy, ongoing, and uncertain, but it has provided us with the opportunity to problematise the knowledge we employ and produce. It has allowed us to investigate our own limits as well as those embedded in our practices. In some cases, this has been a challenging process that has made us reflect on the broader structural dimensions we are embedded in, wondering if it really is possible to adopt a decolonial lens in an EU-funded project, leading us to reflect on whether other labels would be more appropriate to frame the work we are doing (e.g. decentering). However, through the individual and collective reflections that have accompanied the project, we have become increasingly more aware that if we aim to overcome the eco-modernist stance of dominant CE paradigms, we cannot shy away from a critical engagement with the epistemic injustice and blindness that are foundational to those extant paradigms of CE-making.
Future work aims to reflect upon how this engagement developed through the latter two years of the project.

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Part II. MEASURING A JUST TRANSITION TO CIRCULAR ECONOMY

Chapter 10. Beyond GDP: Using alternative macroeconomic indicators to enact an ambitious circular economy

Josep Pinyol Alberich, Leandro J. Llorente-González, Mohammad Javad Ramezankhani, Meletios Bimpizas-Pinis, Benjamin Lowe

Abstract

The circular economy has the potential to promote systemic change towards a sustainable future. However, the dominance of technical and market-oriented considerations has placed the circular economy as part of an eco-modernist agenda, which retains growth in Gross Domestic Product as the overarching priority. In this context, we analyse 12 existing macroeconomic indicators, developed and implemented by governments and international organisations, and determine if they could enact alternative notions of circularity. Specifically, we focus on the *performative* role that indicators can play in both defining and surmounting such reductionist views, thus helping us to address the world we want to create. We find that many of these indicators are agents of the *status quo*, but that some could disrupt the omnipotence of GDP thereby getting the macroeconomic conditions right for a more ambitious understanding of the circular economy.

Keywords: Circularity metrics, environmental sustainability, macroeconomic indicators, resource efficiency, wellbeing.

> We need to ground the development of indicators by engaging local stakeholders in the scope and definition of that which is important to measure. Asserting an ambitious vision of CE can itself have performative impact in this direction and encourage such stakeholder engagement.

10.1 Introduction

Developed as an umbrella concept built on a heterogeneous collection of different schools of thought and research fields such as industrial ecology, biomimicry, cradle-to-cradle design, and cleaner production (Blomsma and Brennan, 2017), the Circular Economy (CE) has emerged as an essentially contested concept, with undefined theoretical boundaries that lack a common and shared definition (Korhonen et al., 2018; Merli et al., 2018). Consequently, as some scholars have pointed out, the CE has predominantly been characterised in apolitical and technocratic terms that suggest a transition to circularity will primarily be led by businesses, practitioners, and policymakers (Genovese and Pansera, 2021). Indeed, the dominance of technical and market-oriented considerations has placed CE as a salient part of the eco-modernist agenda, retaining economic growth (green growth) as its overarching priority, simultaneously underplaying the aim to displace primary production (Corvellec

et al., 2021). Furthermore, CE implementation strategies show scant consideration for social dimensions of sustainability and have a strong focus on 'classic' economic and environmental impacts, both in the academic literature and industrial practice (Calzolari et al., 2022). In the face of the urgent ecological and social damages caused by the current production and consumption system, the limited transformational potential of this reductionist view of the CE has led to a call for a far more ambitious interpretation of the concept (Kovacic et al., 2019; Friant et al, 2020; Lowe and Genovese, 2022; Llorente-Gonzalez and Vence, 2019).
Polanyi's (1977) substantive understanding of human economic activity (as distinct from a more limited definition that equates 'economy' with 'market economy') is useful when grounding such an ambitious approach. In this framework, the current situation in which the global economy is shaped and dominated by market logic and ethics (Harvey, 2005; Kovacic et al., 2019) is understood as a particular and historically located institutional arrangement of the social and ecological relations by which humans interact among themselves and with their physical surroundings to satisfy their needs. This means that both the institutions and the social relations of production they sustain are susceptible to change if they cease to conform to the requirements of human livelihood (Polanyi, 1977). Therefore, the shift towards the CE in response to the present global ecological and social crisis can be regarded not only as a technical reconfiguration of the production processes, but also as a complete systemic transformation of the institutions that regulate humans' material interaction with each other and with nature. Inherent within this, the prevailing economic logic that prioritises the increase in the market value of social outputs also needs to evolve in order to reflect a new set of social values associated with the reconfiguration of the economic system in favour, for example, of global environmental justice and a Social Provisioning approach (Lowe and Genovese, 2022) (see also D1.2 and D1.3 reports of the JUSTCE project).
Consistent with this interpretation, approaches such as the post-growth paradigm exemplified by Kallis (2011), Klitgaard and Krall (2012) and Hanaček et al. (2020), challenge the market-centred vision of the economy and prioritise more ambitious goals such as human welfare and ecological sustainability (Kalimeris et al., 2020; van den Bergh, 2022). These goals better reflect the aims underlying the original systemic notion of the CE, whereby "the essential measure of the success (…) is not production and consumption at all, but the nature, extent, quality, and complexity of the total capital stock, including in this the state of the human bodies and minds included in the system" (Boulding, 1966). How, though, do we disrupt the status quo (and reductionistic visions of the CE), and move towards such ambitious circular futures that are more in line with Polanyi's (1977) substantive understanding of human economic activity?
In this paper, we assert a performative approach to answer this question, and we focus on the role of macroeconomic welfare indicators. Specifically, we suggest that such welfare indicators have the potential to influence the way we enact the economy and thus shape the nature of the economic realities that we can envisage and achieve. In this context, the status quo welfare indicator is currently Gross Domestic Product (GDP) and with it the notion of economic growth. However, as Hale et al. (2019, p.49) put it, "the economy is not GDP – it is enacted in situated practices more heterogenous than something like GDP depicts," but nonetheless, [GDP] has "come to substitute for individual, household, community and national wellbeing" (it has become ontic) despite its well-studied limitations in these areas and calls for alternative welfare indicators (e.g. Daly, 2013; Giannetti et al., 2015; Kalimeris et al., 2020; van den Bergh, 2022). Indeed, leading proponents of the CE including the EU (Colombo et al. 2019; Llorente-González and Vence, 2019; Pinyol Alberich, 2022), China (Llorente-González and Vence, 2019) and the Ellen MacArthur Foundation (Lazarevic and Valve, 2017), still rely on GDP as a principal indicator of reference

when formulating their CE strategies. Therefore, as per Gibson-Graham (2008) we need to be asking what kind of world we want to create, and in response, advancing more ambitious macroeconomic indicators to achieve it.

Whilst there have been important studies that have envisaged futures beyond GDP (e.g. Svenfelt et al., 2019) and a variety of circular futures (e.g. Bauwens et al., 2020; Völker et al. 2020), the performative impact of existing macroeconomic indicators and how they could provide propitious conditions for a transition to an ambitious CE, is not something that has been studied to date. Much of the discussion of macroeconomic indicators for a CE focuses exclusively on China (Saidani et al., 2019) and the measurement of circularity itself rather than overarching welfare indicators that could supplement or replace GDP in the public consciousness. For example, Zhijun and Nailing (2007) have discussed implementing CE in China and the CE indices and indicators needed to affect this, and Geng et al. (2012) provide a critical analysis of China's existing nationally focused CE indicators. Wang et al. (2020) have recently proposed new approaches to measuring circularity in China. Outside of China, De Pascale et al. (2021) and Saidani et al. (2019) have analysed a wide range of potential indicators in the context of the CE, including at the macro level. However, again, the focus has been on circularity indicators. Similarly, Jacobi et al. (2018) and Mayer et al. (2019) have proposed economy-wide biophysical frameworks for the assessment and monitoring of a CE, whilst Schroeder et al. (2019) has discussed the relevance of the CE to the Sustainable Development Goals.

In this context, this study's primary aim is to analyse how alternative macroeconomic indicators could enable us to envision, create and enact ambitious conceptions of the CE. To achieve this, we review a set of indicators according to a simple conceptualisation that understands the economy as being comprised of three pillars: the economic dimension, the environmental dimension, and the social dimension (Carew and Mitchell, 2008; Schaltegger and Wagner, 2017). We do not aim to formulate an ideal approach or system of indicators, or to stray into discussions of modelling the CE that have been effectively addressed elsewhere (e.g., McCarthy et al., 2018). On the contrary, this paper aims to provide an exploratory overview of how innovative existing macroeconomic indicators can enable new visions of the CE. It is, if you like, a practical 'stock take' of what indicators are available now and how these might be augmented further in the future to provide a more hospitable context within which an ambitious CE might be furthered. Indeed, we have pursued this end out of an understanding that specific CE practices can be determined by the way in which we frame, measure and envision the broader macroeconomy.

The paper proceeds as follows. Section 2 presents the methods that were employed to select and analyse the macroeconomic indicators we address here. Section 3 introduces the final 12 indicators selected, as well as the instances where these approaches have been applied in practice. Section 4 discusses the suitability of the various approaches in helping us to define and perform an ambitious CE. Finally, Section 5 concludes and suggests avenues for future research.

10.2 Materials and methods

We selected and classified a range of indicators, frameworks and metrics (henceforth just "indicators") according to the three pillars that reflect the ambition of a functional CE, namely efficiency in resource use, environmental preservation, and wellbeing (Murray et al., 2017; Korhonen et al., 2018). These pillars are also reminiscent of 'sustainability' more generally. However, we rely on the pillars here as an organisational device that captures a broader macroeconomic perspective than a traditional focus on GDP, and because invoking such a framework and broadening the definition of what is important for a CE to measure, can itself lead to performative impact that stimulates the development of additional CE indicators.

We specifically focused on macroeconomic indicators (applicable to cities, regions, nations and beyond) that were in existence when this study was conducted (March 2022), and which had been developed or implemented by NGOs, international governmental organisations, partnerships between universities and governments, or governments themselves. We also prioritised indicators with a relevant track record to examine. As a result, the focus here is more empirical in nature, which distinguishes it from a large part of the academic literature described previously. Moreover, we specifically excluded indicators that are concerned with circularity mechanisms themselves, rather choosing to focus on approaches that address the overarching economic system i.e., we effectively treat the economic system as a 'black box.' The 12 indicators that we settled on were found due to our familiarity, as a five-person research team, with the work in this area and by searching a variety of terms related to macroeconomic indicators. As discussed above, the particular focus of this paper – including academic research but focusing on policy applications – has only been studied to a limited extent. As a result, no firm list of keywords or search terms has yet been established in this specific area.

Table 10.1 and **Figure 10.1** provide an overview of the indicators that will be covered in this paper. As shown, many of these indicators are applicable to more than one pillar. Indeed, whilst we classified the indicators to the most relevant pillar based on the issues they address, in some cases, the scope of the indicators also extends to other pillars. Therefore, in Table 1 the connection between indicators and pillars is classified as either "highly relevant" or "relevant". However, in the discussion that follows, indicators are examined in the section to which they are considered as "highly relevant."

Table 10.1The 12 Indicators covered in the paper (by pillar)

	Created by	**Resource efficiency**	**Environmental sustainability**	**Wellbeing**
National Circularity Gap	Circle Economy (non-for-profit organisation)	✓✓	✓	
EU Resource Efficiency Scoreboard	EU	✓✓		
OECD Green Growth Indicators	OECD	✓✓	✓	
Sustainable Development Indicators	UN	✓	✓✓	✓
Natural Capital Index	Stanford University		✓✓	
Ecological Footprint	Global Footprint Network (non-profit organisation)		✓✓	
Environmental Performance Index	Collaboration between Yale University, Columbia University, and the World Economic Forum		✓✓	
Gross National Happiness Index	Government of Bhutan		✓	✓✓
Canadian Index of Wellbeing	Atkinson Charitable Foundation (before 2011) and University of Waterloo (after 2011)		✓	✓✓
Genuine Progress Indicator	Non-profit organisations and universities across the USA (cases in Vermont, Maryland, Colorado, Ohio, and Utah)		✓	✓✓
European Social Progress Index	EU		✓	✓✓

Size of the Informal Economy (% of GDP)	International Conference of Labour Statisticians			✓✓

Note: ✓✓= highly relevant; ✓= relevant. EU = European Union. OECD = Organisation for Economic Cooperation and Development. UN = United Nations.

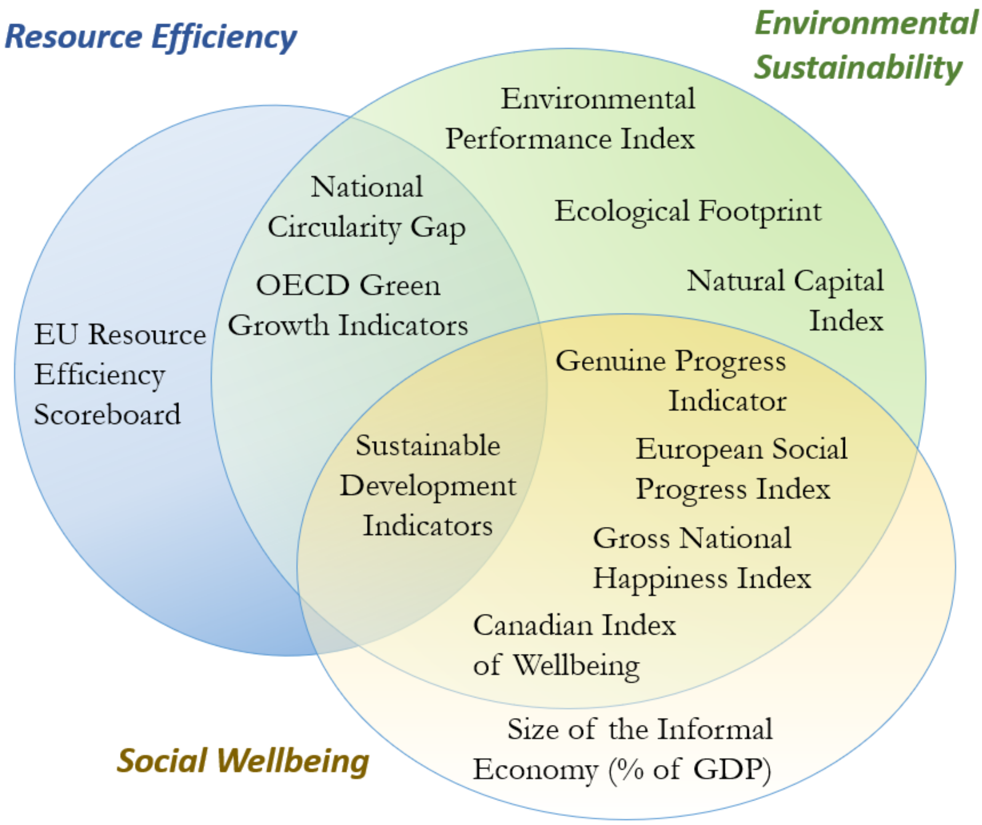

Figure 10.1The 12 Macroeconomic indicators and their relationship to the three pillars

10.3 Macroeconomic indicators for an ambitious CE

The 12 macroeconomic indicators that were selected for analysis here, and the instances where these have been applied to date, are introduced in sections 3.1 (resource efficiency), 3.2 (environmental sustainability) and 3.3. (wellbeing).

10.3.1 Macro-level approaches to resource efficiency

10.3.1.1 National Circularity Gap

The notion of the existence of a "circularity gap" in a territory is derived from the economy-wide MFA approach that quantifies the exchanges of materials and energy in the economy in physical terms (Haas *et al.*, 2015). This involves all the material and energy inputs[8], which can either be incorporated into the physical stocks and end up

[8] The MFA does not include water and air (Eurostat, 2018).

as outputs of the economic process (exports, emissions, and waste) or be recovered/recycled as secondary inputs. The "circularity gap" is then measured as the ratio between the recovered materials and the total amount of resources extracted and used. The most widespread measure of the circularity gap is performed by the non-for-profit organisation Circle Economy, responsible for the Circularity Gap Report initiative (CGRi). The circularity gap is calculated by CGRi mainly at the worldwide level, but it has also been applied at the national level in Austria, Netherlands and Norway, as well as the province of Quebec in Canada (CGRi, 2021).

Some scholars critiqued the National Circularity Gap and similar measures that focus on the level of circularity. Aguilar-Hernandez *et al.* (2019) argue that most circularity gap studies fail to discriminate between the materials that are emitted, added to in-use stocks or disposed of previous stocks. Including these in the material analysis leads to misleading results because they are not actually available for recovery (Aguilar-Hernandez *et al.*, 2019). Another key limitation of the circularity gap is its extreme dependence on how system boundaries are defined. In this regard, it has been reported that the circularity gaps of the richest countries tend to increase significantly when their material recovery rate is put in relation not only to their domestic extraction and direct imports, but with their total global material footprint (Llorente-González and Vence, 2020). Finally, Martínez-Alier (2021) provides a holistic critique of the notion of circularity itself, as it represents an expansion of the resource extraction and waste disposal frontiers of capitalism that does not solve the sustainability challenges of capitalism. Martínez-Alier (2021) postulates that the widespread use of circularity gap could even enable further economic growth through more resource extraction.

10.3.1.2 EU Resource Efficiency Scoreboard

The Resource Efficiency Scoreboard is a composite indicator that was designed by the European Commission (EC) to support the political actions and goals set by the Roadmap to a Resource Efficient Europe, aimed at improving the use of natural resources and monitor the trend for increasing resource productivity amongst the EU members (European Commission, 2011). Its 32 indicators followed a hierarchical structure, with resource efficiency representing the main leading indicator, followed by metrics related to the environmental impacts of resource use and thematic indicators that monitor the transformation of the economy, natural capital and key sectors (European Commission., 2015) (**Figure 10.2**). This scoreboard supports a vision of the economy that maximises the use of existing resources, which is in line with some of the principles of the CE. Resource efficiency, is calculated by dividing GDP by Domestic Material Consumption (DMC), indicating the amount of economic value that can be obtained per physical unit of materials.

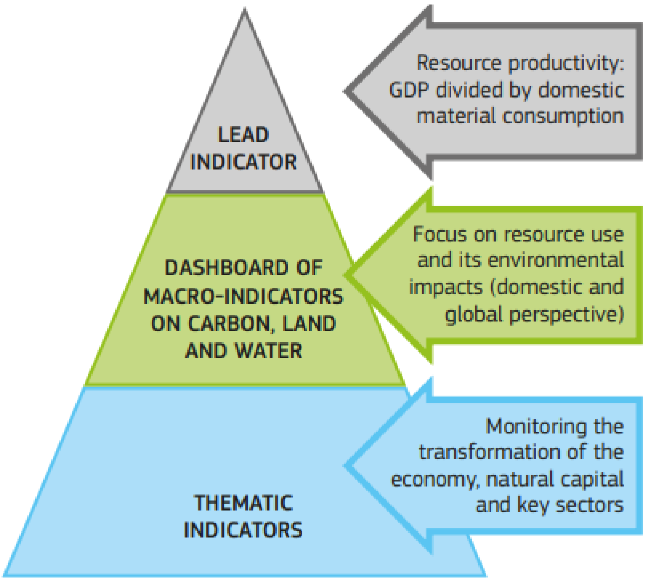

Figure 10.2 Tiered structure of the EU Resource Efficiency Scorecard (Source: Reprinted with permission from European Commission, 2014.)

Many drawbacks have been pointed out in the literature about this approach. The main issue is the fact that this indicator still relies on GDP and does not detach itself from the monetary valuation derived from the market sphere (Ward *et al.*, 2016; Nørgård and Xue, 2017). As a consequence, a rise in prices and/or changes of the economic structure of a country towards activities with higher monetary value added may lead to spurious conclusions about an apparent dematerialisation of the economy. For example, during the international financial crisis in 2008, some European countries registered a remarkable increase in material productivity, simply due to the sharp contraction in the construction sector resulting from the sudden burst of a real estate bubble. Moreover, the indicator may reflect the occurrence of relative decoupling while absolute material use may be still increasing (Ward *et al.*, 2016; Nørgård and Xue, 2017). Finally, the issue of system boundaries also applies to this indicator, as apparent efficiency gains may be obtained through displacement of the material burden to other territories (Korhonen *et al.*, 2018).

10.3.1.3 OECD Green Growth Indicators

The notion of 'green growth' emerged in the last decade as an institutional9 response to the overwhelming evidence regarding the ecological deterioration caused by human economic activity. It is based on the premise that continued GDP growth could be achieved within the ecological limits of the planet, and thus continues the line of previous conceptualisations on sustainable development, such as ecological modernisation and the environmental Kuznets curve hypothesis10 (Popp, 2012; Hickel and Kallis, 2020). Smulders et al. (2014) propose

[9] The concept of "green growth" has been promoted to a great extent by international institutions such as the OECD and the UNEP (Smulders et al., 2014).

[10] The Kuznets curve hypothesis states the existence of an inverted-U relation between economic growth and environmental damage (Cole, Rayner and Bates, 1997), thus prescribing that economic convergence among countries will lead to an overall reduction of the ecological impacts.

a conceptual distinction between the "strong green growth" approach and the "weak green growth" approach. The former is promoted by UNEP, who focus on making growth compatible with environmental preservation, and the latter is advocated by the OECD, whose approach is based on the assumption that it is possible to decouple economic growth and its implicit environmental impact (Smulders et al., 2014; Stoknes and Rockström, 2018). The vision of green growth of the OECD can use the CE as an enabler of green growth in a similar fashion to the notion of a circularity gap, as the CE can expand the limits of resource extraction and intensify resource use to further enable economic growth (Martínez-Alier, 2021).

The OECD Green Growth Indicators framework comprises 26 different indicators, categorised into four groups: (1) environmental and resource productivity, (2) natural asset base, (3) environmental dimension of quality of life, and (4) economic opportunities and policy responses (OECD, 2017). These indicators correlate with the growth of GDP, and measure on how countries improve their green-growth related performance (OECD, 2017; Koçak, 2020). The OECD Green Growth indicators maintains close similarities with the EU Resource Efficiency Scoreboard, as both frameworks are promoted to guide economic policy internationally, and both aim to promote GDP growth while reducing environmental impact. However, the main critique of these indicators is the shared assumption that economic performance is based on enabling economic growth through decoupling. While many experts defend the possibility of decoupling economic growth from resource use and environmental impact (UNEP, 2011; Schandl et al., 2016; Wu et al., 2018), others challenge the feasibility of absolute decoupling. In this sense, some scholars call for the decoupling of material use from variables other than GDP, such as those depicted in the Human Development Index (HDI) (Sanyé-Mengual *et al.*, 2019; Hickel and Kallis, 2020).

10.3.2 Macro-level approaches to environmental sustainability

10.3.2.1 Sustainable Development Indicators

The UN 2030 agenda for Sustainable Development aims to enable peace and prosperity for people and the planet through the adoption of 17 Sustainable Development Goals (SDGs) and 169 targets (UN, 2022) with relevant indicators to measure the advancements. From an ecological perspective, some of the SDGs are compatible with the main principles and goals of circularity, and their corresponding indicators could be used to analyse the transition to the CE. For instance, reducing waste generation through prevention, reduction, recycling, and reuse is currently among the targets of SDG 12 (responsible consumption and production), and the SDG 13 (climate action). Also, the improvement of agricultural productivity by the reduction, recycling and reuse of waste is contemplated in SDG 2 (Zero Hunger) (Barros *et al.*, 2020). Extended use of renewable energy sources, one of the pivotal enablers for constructing the CE (Korhonen *et al.*, 2018), is contemplated in SDG 13 (Climate Action). Also, other SDGs have both direct and indirect links with the environmental aspect of the CE agenda, such as SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), SDG 14 (life below water), and SDG 15 (life on land).

Despite their apparent suitability, the SDG goals are built as a set of indicators instead of a holistic indicator, leading to trade-offs as certain issues can be prioritised over others. For example, poverty-related goals might be prioritised at the expense of other SDGs related to environmental performance (Barbier and Burgess, 2019). Another factor is the attainment of different goals, such as economic growth, climate action, and responsible consumption and production, do not correlate with each other, leading to an increase between the trade-offs and contradictions within the SDG and their indicators (Fonseca *et al.*, 2020).

10.3.2.2 Natural Capital Index

The notion of natural capital is used to describe components of the natural environment that provide valuable goods or services that are critical for society including minerals, fuels, animals, plants, or ecosystems (Mace et al., 2015; Terama et al., 2016; Bateman and Mace, 2020). The Natural Capital Index (NCI) provides a structured and comprehensive approach to measure natural capital and allow decision-makers to take into account national natural capital and ecosystem services when they make decisions about economic development (Mora, 2019; Fairbrass et al., 2020).

NCI has been used in several studies to assess the status of the amount and value of the natural capital in certain locations including Mexico (Mora, 2019), Scotland (McKenna et al., 2019), and the United Kingdom (Stebbings et al., 2021). The use of NCI allows policymakers to track their action and their progress in preserving or improving their natural capital for sustainable development (Terama et al., 2016; Bateman and Mace, 2020). The use of this framework encourages a transition away from production-based indicators towards the consideration of ecological assets, which can be aligned with some of the elements that compose the CE.

A disadvantage of the NCI framework is that it adopts an environmental output perspective to address the societal performance of the economy. Although this perspective aims to weight the value of nature and its preservation, it does not distinguish if the presence of natural capital is caused by an actual shift towards more sustainable practices or by simple geographical luck. Such a perspective provides a limited view of the performance of the economy, as it disconnects the environmental impact of the economy from its ability to satisfy societal needs. Another source of criticism is the commodification of nature implicit in the use of NCI, as environmental values cannot be measured with units as money (Martinez-Alier et al., 1998), or the incompatibility of the monetised nature with market mechanisms (Brockington, 2011).

10.3.2.3 Ecological Footprint

The concept of the Ecological Footprint (EF) of a population was first introduced by Wackernagel and Rees (1996), who defined it as "the area of ecologically productive land (and water) in various classes — cropland, pasture, forests, etc. — that would be required on a continuous basis to (a) provide all the energy/material resources consumed, and (b) absorb all the wastes discharged by that population with prevailing technology, wherever on Earth that land is located" (Andersson and Lindroth, 2001). The EF aligns with the idea that the CE can reduce the environmental impact of the economy. Hence, a strong adoption of CE practices should be translated to a decreased EF in a country.

In practice, the EF is calculated by adding up all the demands for biologically productive space measured in global hectares and is then contrasted with the total available biocapacity (European Commission, 2022). This offers an estimate of the "ecological deficit" incurred by the populations that use resources in excess of their own biocapacity, which is compensated through the consumption of the "ecological reserve" or "credit" belonging to the inhabitants of other territories (Wackernagel et al., 2006). The Environmental Footprint is an indicator that better reflects the impact of the human activity in comparison to the NCI, as it takes into account the demands for resources. This element in especially relevant in a context of a globalised economy where most of resources are not sourced locally within a country, because it allows us to identify how wealthy countries account for global environmental degradation despite having a well-preserved local environment.

EF mainly calculates the total available biodiversity as the share of available land for cultivation and infrastructure is estimated to be equivalent to the amount of land used in practice. Consequently, the methodology does not allow for unused reserves of cropland and buildable land or distinguish between different cultivation techniques and/or ownership regimes, thus reflecting land productivity rather than land management sustainability (Matuštík and Kočí, 2021). EF is used in other measures including Global Footprint Network (GFN) to determine the biodiversity required to absorb the direct and indirect CO2 emissions linked to consumption (Matuštík and Kočí, 2021). Some scholars argue that the EF ends up being a CO2-centred static measure that does not consider potential shifts in the global energy matrix towards options with less ecological impact (van den Bergh and Grazi, 2014). Detractors also point out that the methodology penalises territorially small and commercially open rich countries, regardless of their potential to develop and use renewable energy and exploit their biodiversity more intensively and efficiently.

10.3.2.4 Environmental Performance Index

The Environmental Performance Index (EPI) measures the health of a country's environment and the vitality of a country's ecosystems using 32 measures in 11 categories (EPI, 2022). The EPI represents a collaboration between Yale University, Columbia University, and the World Economic Forum, and has been in operation since 2006, when it replaced the Environmental Sustainability Index (Esty et al., 2005). The EPI's breadth is highlighted by its inclusion of biodiversity and habitat, climate change, and water quality elements, demonstrating its strength as an environmental indicator (Ave and Babolsar, 2010). This index can contribute to a more accurate assessment in the context of the CE, as traditional measures such as GDP do not consider environmental externalities (Kalimeris et al., 2020). In this sense, the EPI and the EF share a common approach when they relativise the environmental impact of a country in relation with its own available environmental resources, while the NCI is limited to only analyse the available natural resources within each country.

One of the strengths of the EPI is that it allows comparisons of the environmental performance across countries (Saisana and Saltelli, 2010; Boleti et al., 2021) and also between sectors within the same country, as in the case of Lithuania (Baležentis et al., 2016). In this sense, the use of EPI can be useful from an output perspective, as it can estimate how much the environmental performance has improved after the adoption of the CE. Some authors point out that the EPI framework does not easily translate environmental performance into practice since it combines elements that do not describe important environmental issues but are important for tracking the performance of these elements as they affect society. For example, air and water pollution are calculated in relation to the impact on humans. As a result, the EPI is strongly correlated with the indicators relevant to environmental stress to human health, while it has a very low correlation with the indicators relevant to ecosystem vitality (Saisana and Saltelli, 2010). This is also true for estimation of wellbeing since it only monitors environmental developments that merely affect human health. Therefore, for a more comprehensive assessment, many scholars combine EPI with other indicators, such as economic growth or the human development index (Ave and Babolsar, 2010; Samimi and Ahmadpour, 2011).

10.3.3 Macro-level approaches to wellbeing

10.3.3.1 Gross National Happiness Index

The Gross National Happiness (GNH) index was created with the intention that sustainable development should take a holistic approach towards notions of progress and give equal importance to non-economic aspects of wellbeing (Thinley, 2012; Ura et al., 2012). The GNH index served as a guiding philosophy for Bhutan's governance based on nine domains (Ura et al., 2012): psychological wellbeing, health, education, time use, cultural diversity and resilience, good governance, community vitality, ecological diversity and resilience, and living standards. By using these nine domains, the GNH index aims to orient the country towards happiness by assessing the presence of the conditions that generate unhappiness.

The novelty of the GNH index is that instead of measuring aggregate or average happiness, it aims to measure how members of the population (in this case Bhutan) reach a "sufficient level" of happiness across a set of dimensions. This approach allows for a stronger focus on wellbeing and its development, leading to improved environmental preservation (Bates, 2009). Considering the fact that social aspects are largely overlooked in conventional economic performance measurement, the GNH index bears the potential to address this issue in the context of the CE. Hence, the use of an index such as the GNH aligns with a vision of the economy that does not necessarily seek economic growth, but social satisfaction, which can lead to a strong version of sustainability.

The GNH proposes an approach that measures social progress while disregarding material production. This allows the GNH to overcome the disadvantages of GDP on the economic policy debate and to provide a vision of economic performance that enables a strong vision of sustainability (Thinley, 2012; Brooks, 2013; Tideman, 2016; Laczniak and Santos, 2018). However, the main weakness of using a happiness-based indicator is that happiness is a subjective, contextual and culturally shaped notion that is defined differently across different societies (Alesina et al., 2001).

10.3.3.2 Canadian Index of Wellbeing

The Canadian Index of Wellbeing (CIW) indicator aims at generating a national, broad, and balanced instrument to show the public the evolution of wellbeing, in all its possible dimensions. The main reason behind the creation of this indicator was the over-reliance on GDP to measure the economic performance of Canada (Graham, 2015; Canadian Index of Wellbeing, 2021). Its creation is a citizen-led initiative that started at the Atkinson Charitable Foundation (ACF) in 1999, when a group of Canadian experts posed the question: "What would it take to create a tool that truly measured Canadian wellbeing?". To calculate CIW, a set of 64 different indicators are extracted from data sources provided by Statistics Canada. These indicators are grouped in 8 different domains: community vitality, democratic engagement, education, environment, healthy populations, leisure and culture, living standards, and time use (Michalos et al., 2011; Morgan, 2011).

The CIW has been used in Canada, together with GDP, to provide a different perspective to decision-makers on the main problems and challenges that Canadian society faces (Canadian Index of Wellbeing, 2021). This represents a critical difference between GNH and CIW: GNH has replaced GDP, whereas CIW is used to complement it. Although policymakers in Canada do not mention the use of the CIW in their CE policies, we can speculate that the use of CIW could align with a vision of the economy that prioritises social welfare instead of growth, which can also lead to a strong version of sustainability in a similar fashion to the GNH.

10.3.3.3 Genuine Progress Indicator

The creation of the Genuine Progress Indicator (GPI) has been motivated by the lack of comprehensiveness of GDP, and the need to create metrics broader than GDP that put economic, environmental and social elements into a common framework and observe progress in a more comprehensive way (Asheim, 2000; Hanley, 2000; Talberth et al., 2007). Thus, the creation of the GPI was an attempt to provide a more accurate measure of welfare and to gauge whether an economy is on a sustainable time path (Cobb et al., 1995; Hamilton, 1999; Costanza et al., 2004).

The use of the GPI as a complement to GDP is shared by the CIW. GPI consists of more than twenty aspects of economic lives that are ignored by GDP (Cobb et al., 1995). These aspects are grouped in the following five categories: (1) built capital, (2) financial assets, (3) natural capital, (4) human capital, and (5) social capital (Hamilton, 1999). The result is an index that attempts to measure our collective welfare in terms of principles of sustainable development drawn from the economic, social, and environmental domains. Moreover, because the GPI explicitly recognises the contribution of unpaid work in the home to economic well-being, it is aligned with feminist and ecological economics as discussed at greater length in D1.3 (Martinez-Alvarez and Barca, 2023) of the JUST2CE project.

One of the main characteristics of GPI is that it considers income distribution, where an increase in the income of the poor carries a higher weight than an increase in income of the wealthy. For example, the difference in income weighting is justified as income inequality and is correlated with several social problems, such as higher rates of drug abuse, incarceration and mistrust, and poorer physical and mental health (Costanza et al., 2004). However, GPI is also criticised for lacking robust valuation techniques and lack of appropriate data to value many of its components that are assumed. For instance, GPI measures the cost of non-monetised elements such as the cost of crime, the cost of noise pollution, the cost of family breakdown, or the cost of lost leisure time (Lawn, 2003). There is no consensus about the valuation process and the data used for measuring some of the aforementioned components.

10.3.3.4 European Social Progress Index

The European Social Progress Index (ESPI) indicator was developed to measure social progress as a complement (and not a substitute) to traditional measures of economic progress, such as GDP. It was developed within the framework of the “Beyond GDP” discussion, and there have been only two editions published, in 2016 and 2020 (European Commission, 2021). The ESPI is developed by the EU-SPI Pilot project and funded by the EC to improve policymaking, in particular for those initiatives aimed at enhancing cohesion across the EU (European Commission, 2022). The Index measures social progress using twelve components that are aggregated into three broader dimensions describing basic, intermediate and more subtle aspects of social progress, respectively: (1) basic human needs: nutrition and basic medical care, water and sanitation, shelter, personal security; (2) foundations of wellbeing: access to basic knowledge, access to information and communication, health and wellness, environmental quality; (3) opportunity: personal rights, personal freedom of choice, tolerance and inclusion, access to advanced education.

The ESPI is intended to complement and not replace GDP. This use and design suggest critical similarities with the CIW and the GPI. However, given the novelty of this indicator and the lack of literature that has analysed it and practices using this indicator, it is challenging to foresee its applicability to policymaking. Given its design and intended use, we can expect that the ESPI will have a similar impact to the GPI and CIW. However, a critical difference of ESPI is that it has been developed by the EU institutions and not an external academic organisation or an NGO. This suggests that the ESPI may have more potential than its Canadian and US counterparts in shaping EU policy. The use of this index could enable a stronger version of sustainability in the CE transition, in a similar fashion to the GPI and CIW.

10.3.3.5 Size of the informal economy (as a percentage of GDP)

The International Conference of Labour Statisticians (ICLS) defined the informal economy as labour that is outside the scope of social protection mechanisms and labour legislation (International Labour Organization, 2003). Some specific examples of the informal economy include child employment, domestic labour, and unpaid care work. GDP is not inclusive of the informal economy, even though it has been estimated to account for more than 60 percent of the World's employed population. It is worth mentioning that the informal economy is associated with social vulnerability due to precarious labour conditions and lack of social protection (International Labour Organization, 2018).

Taking into account the social dimension associated with the quality of employment is particularly relevant for monitoring the transition to CE, as many of the circular activities linked to recovery, repair and reuse have been reported to rely on low remunerations and high rates of unpaid employment (Llorente-González and Vence, 2020). **Table 10.2** provides a summary of the 12 indicators that were included in the final analysis.

Table 10.2 Comparison of alternative indicators/frameworks for measuring economic performance

Indicator/ framework	**Implementation context**	**Elements measured**	**Shortcomings**
National Circularity Gap	43 countries in different regions	Performance in recovering waste	Focused on waste management. Dependent on the geographical definition of recycling (local waste collection vs. local waste processing) and of total material use (domestic use vs. material footprint).
EU Resource Efficiency Scoreboard	European Union	Multi-factor framework consisting of several indicators focusing mainly on: - Resource efficiency - Land/Water productivity - Carbon footprint - Waste management - Supporting research and innovation - Environmental and energy tax - Biodiversity management	Interpretation for some indicators requires extra accuracy since there are indicators that overshadow each other; no social factor has been taken into consideration.
OECD Green Growth Indicators	38 member states of the OECD	Multi-factor framework consisting of several indicators focusing mainly on: - Economic growth - Labour markets - Resource productivity - Biodiversity and ecosystems - Renewable and non-renewable stocks - Environmental dimension of quality of life - Technology and innovation - International financial flows - Environmental taxation	Some of the indicators are still in the phase of development and it is not clear how they are measured; no social factor has been taken into consideration.
Sustainable Development Indicators	UN Inter-agency and Expert Group on SDG Indicators (IAEG-SDGs)	- Climate change - Energy - Zero hunger - Life under water - Life on land - Sustainable cities and communities	The flexibility in which precise indicators are chosen by a nation makes it difficult to make a full comparison across countries.

EPI	180 countries (including Denmark, Luxembourg and Switzerland)	- Environmental health - Ecosystem vitality	The methodology to calculate EPI scores has evolved multiple times since its inception. Furthermore, although the score was calculated in 2020 for 180 countries, a few nations are still missing.
Ecological Footprint		- Environmental impacts - Energy and material consumption - Waste management	This indicator only focuses on the environmental output of the economy and the natural elements present in a country.
NCI	Calculation only in exploratory and academic studies	- Water availability - Biodiversity management - Agricultural fertility - Natural stocks	This indicator only focuses on the environmental output of the economy and the natural elements present in a country.
GNH	Government of Bhutan	- Psychological wellbeing - Health - Education - Time use - Cultural diversity and resilience - Good governance - Community vitality - Ecological diversity and resilience - Living standards	This indicator has been calculated only in Bhutan. It has been developed as an initiative of the monarchy without public involvement.
CIW	Canada	- Community vitality - Democratic engagement - Education - Environment - Population health - Leisure and culture - Living standards - Time use	This indicator has only been used by one country (Canada). The data necessary to calculate this indicator is often unavailable or challenging to calculate.
GPI	State of Vermont, State of Maryland, State of Washington, State of Hawaii (USA)	- Built capital - Financial assets - Natural capital - Human capital - Social capital	This indicator has only been used by a few states within the USA. The data necessary to calculate this indicator is often unavailable or challenging to calculate.
ESPI	European Union	- Nutrition and medical care - Water and sanitation - Shelter - Personal security - Access to knowledge - Access to information and communication - Health and wellness - Environmental quality - Personal rights - Personal freedom - Tolerance and inclusion - Access to advanced education	This indicator is still under development, and it has not been used yet by the EU.
Size of the Informal Economy	South Africa, North Korea, Latin America, Soviet countries, Pakistan, Romania, the	Extent of labour that is outside the scope of social protection and labour legislation.	The informal economy has not been calculated on a regular basis for most nations. Furthermore, there are several methodologies adopted for its calculation, which makes it hard to make reliable comparisons across nations.

	Caribbean, and Spain		

10.4 Discussion

In light of the preceding analysis, there seems to be (at least) two ways in which we could address the main goal of this paper - i.e., to analyse how alternative macroeconomic indicators could enable us to envision, create and enact ambitious conceptions of the CE. First, we could take a narrow pragmatic or technical point of view and think about the extent to which the 12 indicators represent a broader conception of the economy, beyond that offered by GDP, as framed by the three pillars outlined (efficiency in resource use, environmental preservation, and wellbeing). Second, and the main focus of this paper, we could invoke a performative approach and think about how each indicator might itself be an agent that helps us move beyond its specific instrumental merits or demerits and enact a still more ambitious vision of the CE.

Taking a pragmatic or technical approach and starting with the resource efficiency-based approaches, we can see that despite their attempt to combine economic and physical dimensions, they continue to reflect a productivity-based vision of the economy. In this sense, GDP still plays a major role in the calculation of the embedded indicators, ultimately subjecting the results to monetary-price valuation. Consequently, most of the indicators only account for improvements in terms of relative decoupling, which can give rise to the emergence of rebound effects, and therefore may be achieved through absolute increases in resource use (Zink and Geyer, 2017; Figge and Thorpe, 2019). These drawbacks, frequently observed within frameworks that measure efficiency for sustainable development, can play down the importance of focusing on environmental and social issues that the CE claims to address (Geng et al., 2012; Llorente-González and Vence, 2019; Padilla-Rivera et al., 2020).

The case of the National Circularity Gap is different from the other metrics related to resource efficiency. In this case, the National Circularity Gap is built entirely upon physical quantities. It is also focused mainly on materials recovery, in contrast to the EU Resource Efficiency Scoreboard and the Green Growth Indicators, which measure multiple dimensions. The strength of the Circularity Gap is that it provides both a simple and direct measure to keep materials in circulation at the macroeconomic level. However, there are also weaknesses around the lack of accounting for related matters such as the energy consumption of recycling activities, and the potential for misleading results: improvements in the form of a reduction in the circularity gap may be obtained by increasing material efficiency and recycling rates but can also be the result of economic downturns due to recessions or crises. Moreover, this approach has proved to be very sensitive to the criteria chosen to determine the total amount of materials used by an economy (with domestic material consumption and global material footprint as the two extreme cases), and to account for the international trade of recyclable residues. Depending on these crucial methodological decisions it may be possible for a country to reduce its circularity gap by simply shifting the burden to other territories.

With regard to the environmental sustainability-based indicators, these refer to a specific aspect of public priority. For example, the Sustainable Development Indicators, which measure the achievement of the UN's Sustainable Development Goals. Whereas these indicators measure elements related to environmental preservation, they also include metrics related to other dimensions that reflect the levels of social welfare and human development. Nevertheless, it is important to highlight the contribution of indicators such as the EF to account for the unevenly distributed global environmental impacts underpinning the higher levels of welfare, efficiency, and sustainability of the richest countries (Fitzgerald and Auerbach, 2016; Givens et al., 2019; Hickel et al., 2022). This issue of uneven impacts is addressed in D1.2 (Meira et al., 2022) of the JUST2CE project, which discusses how the prevalent and reductionist view of the CE has the potential to drive new forms of global environmental injustice by feeding unequal geographical impacts.

A common problem across the sustainability-based indicators is that there is often not sufficient data available to calculate the indicators for all countries. There is also a notable trade-off between specificity and breadth among the environmental approaches. The SDI are broad and cover many aspects of the environment, whereas EF, EPI, and NCI are limited to calculating the environmental output of the economy. These indicators provide an interesting example of how to acknowledge the environmental performance of a country and to avoid the idea of a profit-driven economy but fail to provide a vision of human development.

Concerning the wellbeing indicators, the definition of wellbeing can vary across cultures and social contexts. Consequently, all the wellbeing-based indicators may be aligned with different notions and policy priorities. For instance, the definition of GPI shares common values with the notion of eco-efficiency, whereas the GNH index aligns with the post-growth paradigm given that it was designed to replace GDP. Moreover, each country has developed its own wellbeing-based indicator given the diversity of ways to define this concept. This represents a challenge because of the implicit social values within each indicator. Also, these indicators differ in the extent to which they are used. While ESPI is an experimental indicator that is not fully established, the other wellbeing indicators (GNH index, CIW, and GPI) are somewhat standard in their respective countries and exert a visible influence on the policy debates where they are implemented. One common observation among all the wellbeing-based indicators is that they diverge in how to operationalise the notion of wellbeing, reflecting different conceptions of this concept. For instance, the CIW includes elements such as democracy, or leisure time, whereas the ESPI focuses on elements such as unemployment or poverty. Another characteristic from most of the wellbeing-based indicators, namely GNH, CIW, GPI and ESPI, is that they place some emphasis on the environment, whether through operationalising and including environmental performance, or by considering metrics reflecting the quality of the environment and nature.

Overall, it seems clear that whilst there are limitations associated with the existing stock of macroeconomic indicators, taken together or in combination, they provide a more comprehensive picture of the economy than GDP, as framed by the three pillars. Namely, these indicators reflect critical elements of the economy, such as the use of materials, the achievement of global goals towards a sustainable development, and the preservation of the environment, and they attempt to conceptualise socially relevant ideas, such as social progress, wellbeing, or happiness. From an instrumental point of view, these indicators can provide critical insights for the development of new indicators to overcome the productivism paradigm associated with GDP, and to enable the development of more ambitious notions of the CE.

Taking a performative stance now, it is clear from the preceding analysis that there are (at least) two broad groups of indicators, which cut across pillars, and reflect differences in underlying assumptions. Gasparatos (2010) suggests that indicators are effectively value articulating institutions (Vatn, 2005) that adhere to embedded worldviews about what is important to measure and how to measure it even if this is not always explicit. On the one hand, the EU Resource Efficiency Scorecard, the OECD Green Growth Indicators and the GPI accord with the concept of eco-efficiency and the broader notion that environmental and social impacts can be monetised and subject to trade-offs, usually via market mechanisms. As a result, these approaches lead us to perform a very specific type of CE, and one that is ideologically aligned with neoclassical economic theory. In their recent paper, Bauwens et al. (2020) articulated four different plausible circular futures, one of which, circular modernism displays a clear faith in technology, markets and consumerism to lead the transition to circularity. It is just such a scenario that is likely to be performed when the focus is on the EU Resource Efficiency Scorecard, the OECD Green Growth Indicators and the GPI (and GDP), a reductionist scenario that is characterised by eco-modernism and the idea of 'green growth.'

On the other hand, indicators such as the Circularity Gap and the GNH do not reflect the same productivism approach. As we have seen, the Circularity Gap measures physical quantities and does not attempt to commensurate these using a monistic numeraire. In a philosophical sense, the GNH is similar in that it attempts to measure social progress in a context that is defined by "sufficient levels" of happiness, which itself depends on minimum conditions. What we have, therefore, is indicators that are not as sympathetic to competitive markets and that, as a result, leads us to perform alternative and (some might say) more ambitious versions of the CE. For example, Bauwens et al. (2020) define a bottom-up sufficiency scenario, which is critical of the eco-efficiency agenda and more attuned to the de-growth literature. Indeed, the primary focus in this scenario is on reducing resource consumption rather than increasing resource productivity. Consequently, higher R strategies – such as refuse, reduce and reuse – are privileged. In such a context, where economic growth in no longer the priority, "it is conceivable that this scenario is more likely to focus on resilience and ecological integrity rather than cost-based notions of efficiency" (Lowe and Genovese, 2022, p.10). As a result, indicators that observe thresholds and limits may be the most compatible and thus most able to enact such alternate and ambitious visions of the CE.

Reflecting on these underlying assumptions helps us to design indicators in a more thoughtful and impactful way, considering their potential performative impact. Indeed, to really to be able to disrupt the omnipotence of GDP and help us to address what kind of world we want, as Gasparatos (2010) says, the selection of indicators "needs to be consistent with the values of affected stakeholders" (p.1613). Therefore, given the selection of any indicator is contingent on a set of societal values and public objectives, the scrutiny of these potential indicators should be opened to the general public and their design should allow civil society to determine the main priorities based on their own needs. In this sense, the case of the CIW of Canada provides a good example of how to develop an indicator engaging civil society organisations and scholars to provide a new macroeconomic logic. More specifically, most of the indicators analysed are complex and multicriteria indicators, which aim to complement GDP. 11 Examples of this are the CIW, GPI, ESPI, and the SDIs. These indicators allow complex and multi-dimensional phenomena to be summarised. However, incorporating diverse criteria into a single measurement needs an approach to balance elements such as resource efficiency and environmental and social factors in a way that is widely accepted in different contexts, and it is in this respect that affected stakeholders also need to be considered.

In addition, though, there is clearly a tension here: such complex indicators take a holistic approach, but their very complexity may mean that the indicator does not become ontic in the same way that GDP has done i.e., it does not end up substituting for the goal it is meant to represent and thus does not impact the anticipated stakeholders. This represents a dilemma for policy makers who may rightly be wary of the tendency to search for one single almighty indicator given that the CE is more inclined towards an understanding of the economy as a system of complex social relations embedded into broader ecological system. Furthermore, this view could be reinforced given the role of power relations in defining the abstractions that indicators come to represent.

[11] To date, only the GNH index has been used to replace GDP.

Where does that leave us then? Picking up on this idea of power relations, perhaps the real challenge is not replacing or augmenting GDP per se but making sure that the reductive influence of an indicator or indicators does not end up serving the primary interests of the powerful and therefore simply measuring what is acceptable rather than what is necessary to achieve our ambitions (Hale et al., 2019). As part of this, we must recognise that the tendency to utilise a pillar-based approach, whilst intuitive as an organisational device, can reinforce ontological boundaries and exacerbate inequities given that this masks how these silos are "often overlapping, co-constructed, and experienced differently in local experience" (Ibid, p.49). Moreover, such an approach risks stymying the emergence of new priorities beyond the pillars such as social resilience, cultural preservation or geopolitical safety. Therefore, to obtain performative impact in a positive sense, impact that goes far beyond what indicators are meant to represent.

10.5 Conclusion

The CE is an essentially contested concept which has increasingly become associated with ecomodernism and a concomitant focus on GDP growth rather than the displacement of primary production. Consequently, the ontic nature of GDP – whereby it "substitute[s] for individual, household, community and national wellbeing" – goes unchallenged by this dominant and reductionist conception of circularity (Hale et al., 2019). This is the starting point for this paper, which aimed to analyse how alternative and more ambitious conceptions of a CE can be more or less determined by the way in which we frame, measure and envision the broader macroeconomy. In other words, we have sort to assert a performative approach to macroeconomic indicators and think about how these can help us create the world we want and one that is more attuned to Polanyi's (1977) substantive understanding of human economic activity.

With this in mind, this paper analysed 12 macroeconomic indicators across three pillars that have been used to define a CE – resource efficiency, environmental sustainability, and social wellbeing – and which together provide a broader conception of macroeconomic logic that includes environmental and social elements. These indicators have all been developed and implemented by international organisations, civil society organisations, and public institutions, thus providing a relevant track record and a practical appreciation of the approaches in these three areas that are currently available. As described earlier, this is a practical exercise in taking stock of what indicators are available now and how these might be augmented further in the future to provide a more hospitable context within which an ambitious CE might be furthered

The 12 indicators were discussed in instrumental terms (i.e., the extent to which their merits and demerits allow us to measure the three pillars that we focused on) and in performative terms (i.e. how the indicators allow us to transcend a reductionist view of the CE and further alternative CE visions). Overall, we suggested that despite significant limitations, the indicators reflect critical elements of the economy missed when giving pre-eminence to GDP, and thus provide guidance for the development of new indicators to overcome the productivism paradigm characteristic of GDP. However, in addition, reflecting on the performative potential of indicators, we suggested that this allows us to design indicators in a more thoughtful and impactful way. Indeed, the potential for performative impact demands that the design of indicators is opened to affected stakeholders, not least to ensure that the reductive power of indicators does not end up going unquestioned and serving the interests of the powerful.

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Chapter 11. Integrated indicators for the assessment of economic, social and environmental benefits

Marco Casazza

Abstract

Despite the multiple inherent meaning of the word 'sustainability', scholars tried to implement different sustainability quantifiers, either as overall sustainability indicators or focusing on the different sustainability pillars, that include its environmental, economic, social and cultural dimensions. This contribution assesses, through a bibliometric analysis, the indexed peer-reviewed research and review articles discussing about the sustainability indicators or their specific implementation in relation to the existing sustainability pillars. From this analysis, it appears that they are primarily meant as tools to support decision-making, environmental protection and sustainability assessment. Alternative ways to represent sustainability, spanning from qualitative indicators to art-based research approaches, are also discussed. These tools, that cannot be seen as disentangled from their policy purpose and as separate from the imperative of social justice, should be understood both as instruments to produce new scientific knowledge and as instruments for supporting the process of political norm creation through the generation of narratives, which can be used to encourage the adoption of just circular economy solutions in real industrial processes, without neglecting environmental and economic well-being, as well as the need of diffused social benefits within the current and future generations.

Keywords: sustainability; sustainability indicators; social justice; qualitative indicators; art-based research

This contribution assesses, through a bibliometric analysis, the indexed peer-reviewed research and review articles discussing about the sustainability indicators. Then, alternative ways to support the envisioning of transition roadmaps toward more sustainable and just circular economy lifestyles are discussed.

11.1 Introduction

Back in 1987, sustainability was defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs". Starting from this definition, the United Nations fixed different targets, such as The United Nations Millennium Development Goals (MDGs), which were 8 goals that UN Member States tried to achieve by the year 2015. Then, a list of 17 Sustainable Development Goals (SDGs) were introduced in 2015, trying to address the challenges that were still open from the MDGs. The SDGs were fixed as a starting point and desired list of universal objectives to ensure a sustainable lifestyle within a safe space for the planet by 2030. In parallel, the United Nations proposed an action roadmap, known as Agenda 2030, fixing 169 targets correlated with the SDGs (United Nations, 2015).
Despite these roadmaps and despite the huge technological progress done in supporting cleaner production processes, we are still far from reaching these goals. United Nations points out that in the year 2019 the material footprint per capita of high-income countries was 24 metric tons while that of lower countries was 2.5 metric tons[12]. These data raise evident concerns in terms of social and environmental justice and equitable distribution of available resources and environmental costs of current development patterns within and among generations (Cocklin and Moon, 2020).
Looking to existing conflicts, having different origins and triggers, it is easy to consider that geopolitical conditions, as well as the lack of transparency and accountability of some governments, can lead to a dangerous inertia, if not to favourable conflict conditions, that hamper the process of reaching the SDGs. There is an intrinsic problem of sincerity, which is critical for addressing global sustainability. Then, again, there should be a mechanism to guarantee the transparency and accountability of policy makers. In fact, without such a mechanism, the most likely outcome of any multilateral agreement consists in "empty promises, without consequence for those that made them" (King and Paris, 2021).
It is recognized that humans, through their activities have altered the planet, generating a visible impact, that has been especially related to a geological epoch, the Anthropocene, that has been included in geological time scales standardized classification. The primary effects of human activities, acting as a relevant geological process, consists in multiple inter-related environmental impacts, altering a previously existing safe space for humanity. For such a reason, the concept of planetary boundaries was introduced to account for large-scale environmental causes of major risks for sustainability and for all the biosphere.
The observed alterations require to be approached in a new way, needing a systemic representation to capture and model such a complex dynamics (Phillips, 2020). This idea doesn't fall far from the idea of macroscope, that was proposed in developing an energy-based system theory for ecology (Odum and Odum, 1994). However, prior to defining such a systemic approach, a revision should start from the key concepts. In fact, only clear and univocal definitions can lead to clear quantifications. If the objective is 'sustainability', what is sustainability should be clarified in order to identify how quantitative indicators of sustainability can be shaped.
Many issues, pertinent to sustainability, are discussed every day, starting from renewable energy, circular economy, climate change or ongoing environmental and social conflicts (Meira et al., 2022). Governments and international bodies promise national and international actions to address these issues. Considering that the definition of sustainability deals with the needs of humans, how these present and future needs could be

[12] UN, SDG 12: https://sdgs.un.org/goals/goal12

quantified? With respect to the definition of sustainable development, what is a 'need' and how can it be quantified? In fact, what a need is should be defined in an univocal way to guarantee the univocity of a quantification method. Instead, it becomes clear that the definition of sustainability is non-univocal.

A recent investigation among sustainability scholars led to the emergence of four distinct areas under which sustainability was labelled (Aminpour et al., 2020): Environmental concerns, Common understanding, neo-Malthusian environmentalism and Sustainability as well-being. These four perspectives can be summarized in the following ways: (1) Sustainability and unsustainability are a matter of environmental degradation, energy sources and their consumption, being the consequence of different interacting physical phenomena; (2) Sustainability is the multi-scale effect of interdependent economic, social and environmental development, being dependent on intergenerational equity; (3) Sustainability is contrasted by technologies, that have a predominant de-humanizing impact, which should be opposed by no-growth economy paradigms, promoting ethical values and superior social goals, questioning the validity of growth as a societal goal, while considering the harmonization of social and economic objectives with ecological management as a more suitable approach; (4) Sustainability is the effect of a management producing a stable availability of natural and human-made resources to guarantee a stable well-being of present and future generations. Other researchers tried to develop a new understanding of sustainability in the context of the Anthropocene. Starting from post-humanist and new-materialist perspectives, disrupting the traditional binary approach, being typical of western philosophy, theorizing thing-power and using art-based research, considering system thinking and other theories, like quantum mechanics, from a not-always-correct and acceptable common-sense perspective, scholars proposed to develop new subjectivities as the means for decentring the human and to move from anthropocentrism toward ecocentrism (Jeong et al., 2018). Other scholars stressed the relevance of indigenous concepts and values, which should be included into the definition of sustainability (Virtanen et al., 2020): context-based relationality, community-based governance, education, language, quality of life and health, and communal recognition of certain nonhumans as life-givers. Considering the multi-faceted nature of sustainability research, a study proved that there is a general tendency to concentrate the attention on the environmental dimension of sustainability, especially in relation to ecosystems, natural resources, environmental protection and conservation (Salas-Zapata et al., 2018). Finally, Feminist Ecological Economics reject the concept of sustainability within the framework of sustainable development due to its focus on GDP as the main measure of well-being, which excludes a proper consideration of reproduction and care work. This vision completely changes the relationships between human beings and the biosphere compared to that mainly focused on production and consumption (Martinez Alvarez and Barca, 2023).

Plurality is inherent to sustainability studies. Researchers and organizations continuously reshape the definition of sustainability, depending on their perspectives and motivations. This plurality is reflected in the top and lowest ten keywords used in scientific papers in combination with 'sustainability' and 'sustainable' (Lima and Partidario, 2020). The used words span from 'environment', 'social' and 'economic' to 'wicked', 'interdependence' and 'interconnection'. This ambiguous plurality of concepts and keywords mirrors the fragmentation of knowledge, the multiplicity and, sometimes, arbitrariness of interpretations, as well as the contrasting paradigms in sustainability studies. This suggests that sustainability is a wicked problem, being time and space (context) specific, without simple or unique solutions and involving actors with multiple perspectives. Thus, all the evidence points to the need of "questioning old perspectives and developing new ones" (Ramos et al., 2020). This questioning and research of new horizons should start from the very beginning, including the definition of sustainability.

Based on the multiple visions of sustainability, it is obvious that devising a unified sustainability metrics would be impossible. The attention, then, has to be moved to the narrative purpose of indicators, which cannot support a univocal identification of target goals, distance-to-target when applied to a specific socio-cultural context (Renn et al., 2020). In fact, to convert raw data into clear and transparent information contents, besides an appropriate choices of indicators, narratives are indispensable (Liu et al., 2018). The narratives chosen to drive a transition toward a more sustainable and just lifestyle should be comprehensible to all, as well as supported by shared social norms of recognized value and also supported by indicators able to provide a transparent quantification of target and distance-to-targets. The relevance of such a connection between indicators and narrative was already recognized by those who developed the Multiple-Scale Integrated Assessments of Societal Metabolism (MuSIASEM) methodology (Maldonado et al., 2019). Finally, attention should be paid to potential incoherencies in the narratives supported by the chosen indicators (Liu et al., 2017).
Despite the plurality of sustainability definitions, perspectives and narratives, several scholars have tried to develop indicators to quantify sustainability under different aspects (see also chapter 10 in this volume). Moving from the definition of sustainability to its quantification, this chapter will try to summarize an up-to-date knowledge on these indicators, based on a bibliometric analysis. In parallel, considering indicators as instruments supporting the visualization of alternative desirable sustainable futures, alternative envisioning instruments will be also discussed. The next section will highlight the methods used to perform the proposed bibliometric analysis. Then, results will be detailed, followed by a discussion and a brief conclusive paragraph.

11.2 Method

A bibliometric analysis was performed in relation to published research or review articles dealing with sustainability indicators. In particular, data were retrieved from Scopus (Sc) and Web of Science (WoS) databases, using "sustainability indicator" as search keyword. No time limitation was given for the search. The analysis included only research and review articles, published in peer-reviewed journals.
The research on Sc produced 4390 works, from which 3358 research or review papers were selected. In the case of WoS database, from a starting number of 679 works, 574 articles were identified. The bibliographic and bibliometric data were downloaded as files in *.ris format, including the names of the authors, the article titles, the basic article data (journal, year, volume, issue and pages), the abstract and keywords, the references as well as the number of citations. Successively, the data files were merged into a unique file, removing the duplicates. Then, 13 incomplete bibliographic files were removed, reaching a total of 3414 works.
Following the same selection criteria, parallel searches were performed using the following keywords: "environmental sustainability" AND "indicator"; "economic sustainability" AND "indicator"; "social sustainability" AND "indicator"; "cultural sustainability" AND "indicator". The purpose of this research was to map the published peer-reviewed indexed works dealing with the implementation and application of indicators to different sustainability pillars. A total of 3907 works were selected, with the following subdivision: 2579 (environmental sustainability), 601 (economic sustainability), 678 (social sustainability), 49 (cultural sustainability).
SciMAT and VOS viewer open-source software were used to perform a bibliometric analysis and to derive the author and keyword landscapes (i.e., to assess the association strength among authors working within the selected bibliographical database) (Cobo et al., 2012; van Eck and Waltman, 2010).

11.3 Results

11.3.1 Sustainability indicators

Table **11.1** contains the subdivision of publications with respect to different 5-years interval periods (1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014, 2015-2019, 2020-2023). Results indicate that the literature on sustainability indicators started in the same period of the Brundtland Commission (1987). Since then, a growing number of works was published.

Table 11.1 Number of scientific publications on sustainability indicators subdivided per years period

Years period	Number of publications
1985-1989	1
1990-1994	2
1995-1999	76
2000-2004	150
2005-2009	298
2010-2014	569
2015-2019	1024
2020-2023	1289

Table 11.2 indicates the top fifty authors, who published peer reviewed works (i.e., research or review articles) on sustainability indicators. The table also indicates the number of published works on this topic for each author. The number of published works per author could indicate that either the bibliographic search was not able to fully capture the number of authors' contributions to the literature on sustainability indicators or that the number of authors' contributions to this topic remains limited. In fact, 10 works out of a total number of 3414 would correspond to a maximum contribution percentage of 0.29% per author.

Table 11.2 Top fifty authors and number of published peer-reviewed works (research or review articles) on sustainability indicators

Author [Surname, N.]	Number of Documents
Morse, S.	10
Zhang, J.	10
Chowdhury, H.	9
Chowdhury, T.	9
Bastianoni, S.	9
Azapagic, A.	9
Li, X.	9
Li, H.	9
Onat, N.C.	9
Sait, S.M.	8
Ruiz-Mercado, G.J.	8
Liu, G.	8
Liu, Z.	8

Author [Surname, N.]	Number of Documents
Spangenberg, J.H.	8
Dale, V.H.	8
Li, M.	8
Veleva, V.	8
Pulselli, F.M.	8

Based on the authors' list contained in the analysed bibliographical record, the authors' landscape was produced (**Figure 11.1**). This graphical representation indicates the association strength among these authors in relation to the input bibliographical record. Consequently, this association map refers to the connection among identified authors with respect to the search topic. Then, eleven relevant authors clusters were identified, that are reproduced in different colours in the figure.

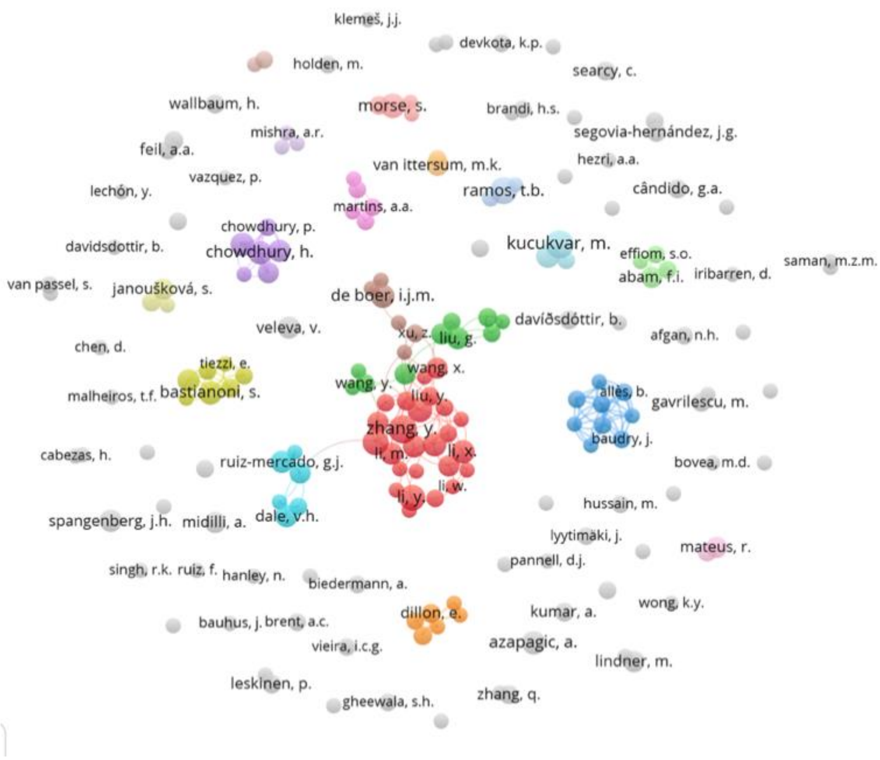

Figure 11.1 Authors landscape, produced through VOSviewer software, displaying the connection among Authors, who published at least one peer-reviewed document (i.e., research or review article) dealing with sustainability indicators

The list of the top ten journals that published works on sustainability indicators is reported in **Table 11.3**, indicating also the number of documents, displaying that the top three journals, that published works on sustainability indicators currently are Sustainability (MDPI), Journal of Cleaner Production (Elsevier) and Ecological Indicators (Elsevier).

Table 11.3 Top ten authors and number of published peer-reviewed works (research or review article) on sustainability indicators

Journal Name	Number of documents
Sustainability (Switzerland)	290
Journal of Cleaner Production	190
Ecological Indicators	126
Environment, Development and Sustainability	47
Ecological Economics	45
Sustainable Development	38
Journal of Environmental Management	35
Renewable and Sustainable Energy Reviews	35
WIT Transactions on Ecology and the Environment	34
International Journal of Sustainable Development and World Ecology	32

The top ten keywords used in the publications captured by the bibliographic research, indicating also the number of documents in which the keywords appear, is reported in **Table 11.4**. Then, considering the keywords, a landscape of co-occurrence strength was produced using VOSviewer. The obtained landscape is reproduced in **Figure 11.2**.

Table 11.4 Top ten keywords and number of documents (research or review article) on sustainability indicators in which the keyword appears

Keyword	Number of documents
Sustainability	1686
Sustainable-Development	1597
Sustainability-Indicators	1440
Decision-Making	397
Environmental-Protection	358
Sustainability-Assessment	318
Indicators	268
Environmental-Impact	260
Environmental-Indicator	202
Life-Cycle	190

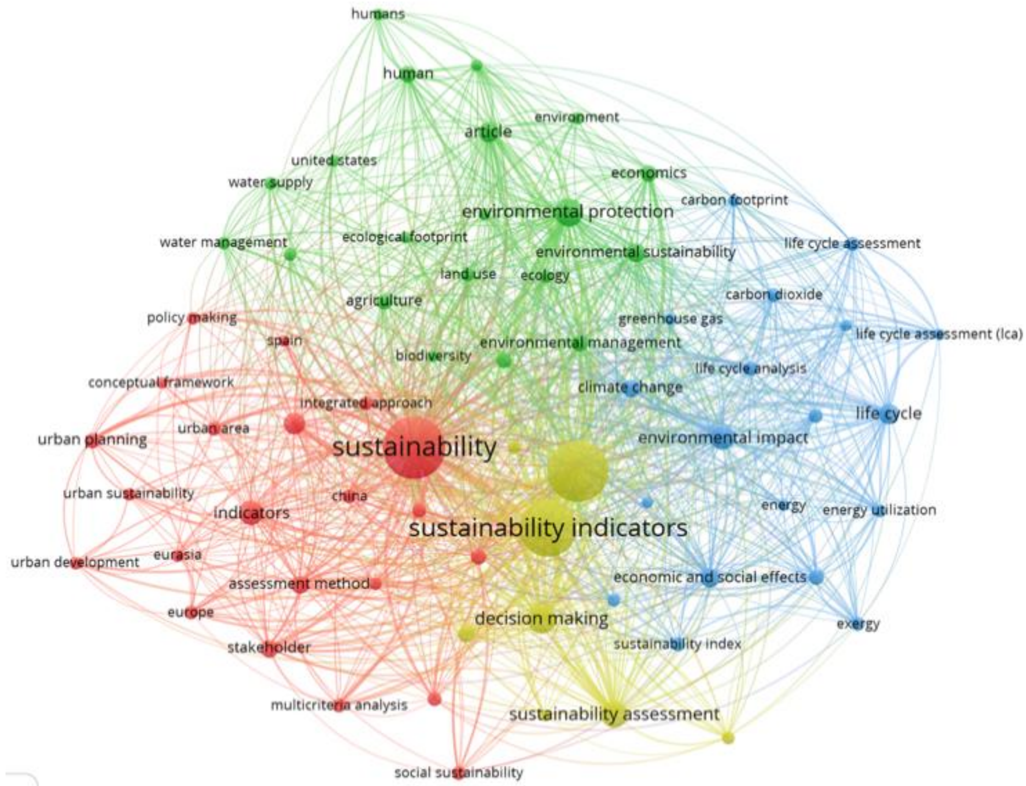

Figure 11.2 Keywords landscape, produced through VOSviewer software, displaying the connection among keywords used at least in one peer-reviewed document (i.e., research or review article) dealing with sustainability indicators

According to the **Figure 11.2**, in agreement with **Table 11.3**, the top 2 keywords, visible as larger circles, are "sustainability" and "sustainability indictors". Then, four co-occurrence areas are identified in the map with different colours. The area in red pertains to the application of sustainability indicators for urban studies. The area in yellow identifies the application of sustainability indicators for decision making. The area in blue connects the use of sustainability indicators with LCA and similar approaches, mainly focused on the accounting of resources (i.e., materials and energy) flows and the assessment of potential impacts through environmental accounting practices. Finally, the area in green mainly identifies the application of sustainability indicators to land use and water use, as well as their correlation with footprint indicators.

11.3.2 Specific sustainability indicators

A second round of bibliometric research and analysis considered the application of sustainability indicators to specific sustainability pillars. With this in mind, together with the three traditional pillars (i.e., environmental, economic and social sustainability), cultural sustainability was included (Meireis and Rippl, 2018).

Table 11.5 reports the number of peer-reviewed research or review articles published in different time periods, starting from 1990-1994 to 2020-2023. Each column of the table indicates the number of published articles with respect to their focus (i.e., environmental, economic, social or cultural sustainability). The results show that the first published work concentrated on economic sustainability. The literature on environmental sustainability emerged later, together with the studies on social sustainability. However, the attention prevalently concentrated on the environmental dimension. The studies on cultural sustainability started to appear later, in the period 2005-2009. All the focus areas display a growing trend of published works.

Table 11.5 Number of peer-reviewed published documents (research or review article) dealing with environmental, economic, social or cultural sustainability, classified according to seven years periods (1990-1994, 1995-1999, 2000-2004, 2005-2009, 2010-2014, 2015-2019, 2020-2023)

Year period	Environmental sustainability	Economic sustainability	Social sustainability	Cultural sustainability
	Number of documents			
1990-1994	0	1	0	0
1995-1999	17	2	8	0
2000-2004	64	6	14	0
2005-2009	136	25	33	1
2010-2014	348	71	62	9
2015-2019	741	203	175	15
2020-2023	1273	370	309	24

The **Figure 11.3** reports the same results in the form of histograms.

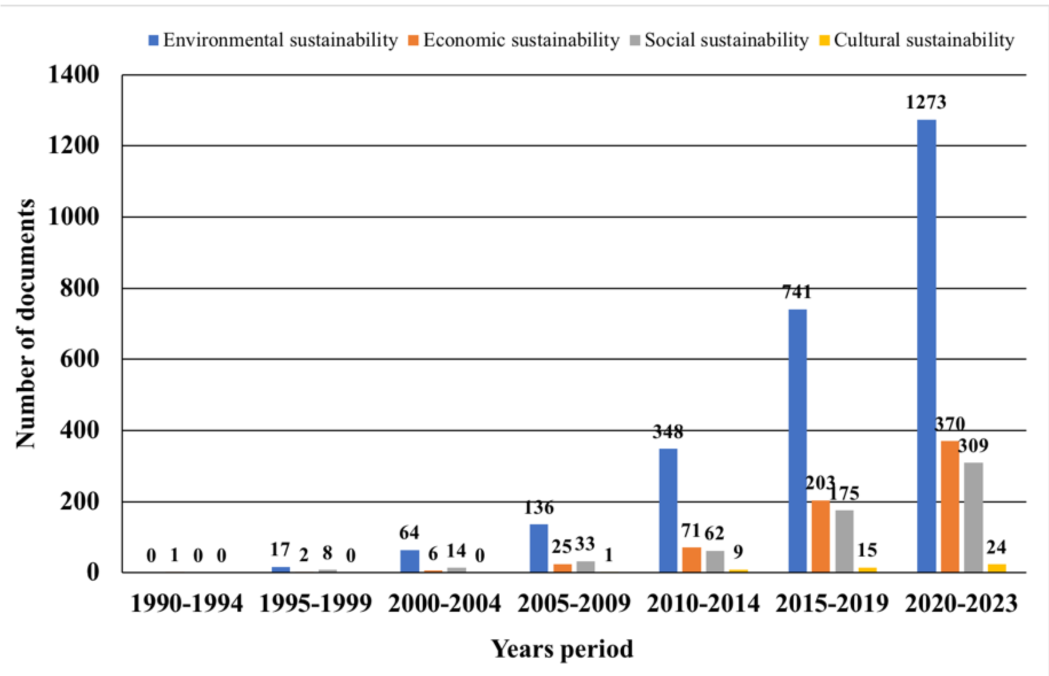

Figure 11.3 Number of documents (i.e., research or review article), grouped according to different years periods, dealing with environmental sustainability indicators

Table 11.6 identifies the top ten keywords and the corresponding number of documents of works dealing with environmental sustainability indicators. With this respect the identified top three keywords used in these works were "environmental sustainability", "sustainable development" and "sustainability". Other keywords include the dimensions of environmental impact, protection and management, as well as the life cycle assessment.

Table 11.6 Top ten keywords and number of documents (research or review article) on environmental sustainability indicators in which the keyword appears

Keyword	Number of documents
Environmental-Sustainability	1362
Sustainable-Development	1143
Sustainability	1143
Article	624
Environmental-Impact	411
Human	308
Environmental-Management	257
Environmental-Protection	255
Life-Cycle-Assessment	239
Decision-Making	231

Table 11.7 identifies the top ten keywords and the corresponding number of documents of works dealing with economic sustainability indicators. With this respect the identified top three keywords used in these works were "sustainability", "sustainable development" and "economic sustainability". Together with economic sustainability, however, the environmental dimension still appears to be relevant.

Table 11.7 Top ten keywords and number of documents (research or review article) on economic sustainability indicators in which the keyword appears

Keyword	Number of documents
Sustainability	234
Sustainable-Development	220
Economic-Sustainability	184
Environmental-Sustainability	76
Economic-Analysis	47
Article	42
Sustainability-Indicators	39
Environmental-Impact	36
Social-Sustainability	36
Economic-And-Social-Effects	34

Table 11.8 identifies the top ten keywords and the corresponding number of documents of works dealing with social sustainability indicators. With this respect the identified top three keywords used in these works were "sustainability", "social sustainability" and "sustainable development". Together with the social dimension of sustainability, the economic and environmental dimensions, together with LCA appear to be still relevant.

Table 2 Top ten keywords and number of documents (research or review article) on social sustainability indicators in which the keyword appears

Keyword	Number of documents
Sustainability	319

Keyword	Number of documents
Social-Sustainability	294
Sustainable-Development	280
Decision-Making	73
Environmental-Sustainability	71
Economic-And-Social-Effects	61
Sustainability-Indicators	60
Indicators	55
Life-Cycle	49
Sustainability-Assessment	43

Table 11.9 identifies the top ten keywords and the corresponding number of documents of works dealing with economic sustainability indicators. With this respect the identified top three keywords used in these works were “sustainability”, “sustainable development” and “cultural sustainability”. Surprisingly, in the case of cultural sustainability, there is “bioenergy” as unusual keyword together with China, indicating that most of the studies on this topic might have considered China as main geographic area for the quantification of cultural sustainability indicators.

Table 3.9 Top ten keywords and number of documents (research or review article) on cultural sustainability indicators in which the keyword appears

Keyword	Number of documents
Sustainability	22
Sustainable-Development	16
Cultural-Sustainability	13
Sustainability-Assessment	6
Indicators	5
Bioenergy	5
China	4
Sustainability-Indicators	4
Cultural-Heritage	4
Culture	4

11.4 Discussion

Results of the bibliometric analysis show that the studies on sustainability indicators are growing, paralleled by studies which concentrated their quantification efforts on different sustainability pillars (i.e., environmental, economic, social or cultural). These indicators, as proven by the keywords occurrence and as confirmed by the literature, are mainly aimed at decision-making, environmental protection, and sustainability assessment. In particular, indicators are meant to produce or support a representation and cannot be seen separately from their narrative purpose, which is a policy instrument, that shouldn't be disentangled from social justice (Astleithner and

Hamedinger, 2003; Fredericks, 2012). With this respect, the scientific knowledge derived from indicators and the evolution in the process of political norm creation, that stem from the definition and the application of sustainability indicators, should be properly acknowledged (Rametsteiner et al., 2011). Consequently, policy-makers and scientists with different disciplinary background should contribute in a process of knowledge co-creation. In parallel, policy-makers, representing different policy domains, should contribute to the same process, adjusting also the defined indicators according to changing political and social norms. In the case of a transition toward just circular economy models and behaviours, the definition and application of sustainability indicators should evolve, supported by recommendations, policies and incentives, to encourage the adoption of just circular economy solutions in real industrial processes, without neglecting environmental and economic well-being, as well as the need of diffused social benefits (Ngan et al., 2019).

Quantitative indicators are one of the tools that can be used to support an environmentally-, economically- and socially-sustainable transition, supporting the implementation of policies to adopt just circular economy solutions. In parallel, there are other ways that can be used to support the transition toward more sustainable lifestyles through the generation of narratives.

First, there are qualitative sustainability indicators. **Figure 11.4** represents the number of published works, in different years periods, dealing with this type of indicators. The research domain of qualitative sustainability indicators is quite recent, since the first published articles appeared in 2016. A peak of published works was recorded in year 2021. This year corresponds to one year after the COVID-19 pandemics, when it was more difficult to collect field quantitative data, but when it was still possible to collect qualitative data through online questionnaires. Obviously, from a deeper analysis, we might expect a biased geographic or socio-economic production of results, associated to the possibility of being online or connected to the world wide web. However, these biases still require to be assessed.

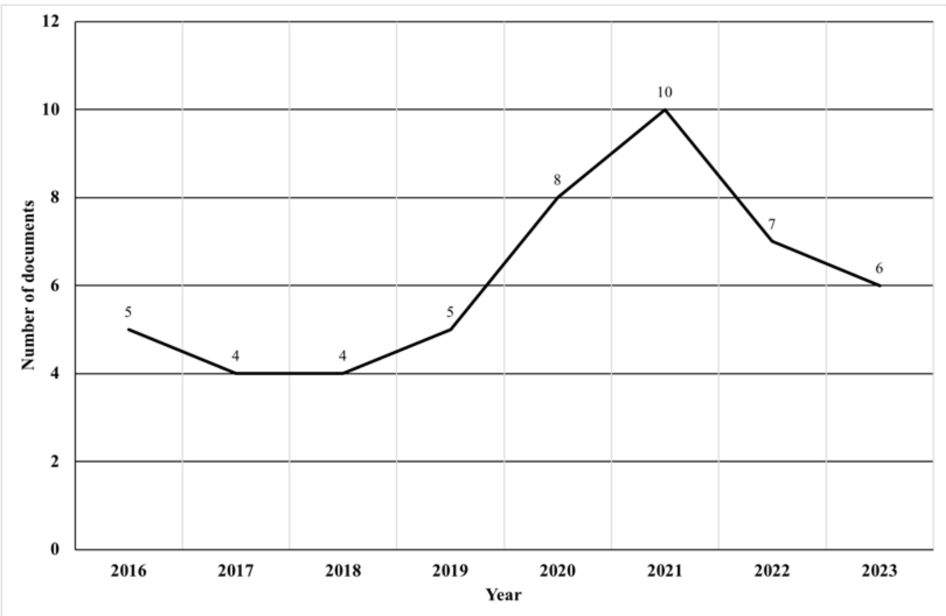

Figure 11.4 Number of documents (i.e., research or review article), grouped according to different periods, dealing with qualitative environmental sustainability indicators

Other non-quantitative ways, that could either generate visions of desirable sustainable futures or support a better understanding of more sustainable and just lifestyles, connected to the pre-industrial epoch, derive from humanities. Archaeology and history, in fact, could provide a documental and material evidence, that, in integration with existing knowledge, could support decision-making in different sectors, such as agriculture (Alciati and Casazza, 2018; de Vingo et al., 2019; Guttmann-Bond, 2010; LeFebvre et al., 2022). Alternatively, art-based research, as first person science paralleling traditional ("third-person") hard sciences, serves as alternative reflective and enquiry approaches, that, starting from a non-normative perspective, can support the identification of appropriate actions, as well as the motivation to pursue specific sustainability goals (Liu et al., 2021). This is why different artistic and performing languages were used as enquiry instruments in the context of sustainability studies (Casazza et al., 2017; Casazza and Gioppo, 2020; Muhr, 2020). Thus, alternative ways, spanning from qualitative indicators to art-based research approaches, can serve as instruments or methods, that can support, in integration with qualitative approaches, the envisioning of transition roadmaps toward more sustainable and just lifestyles.

11.5 Conclusions

As shown in this contribution, the number of studies investigating alternative or complementary approaches to quantify the sustainability or certain sustainability dimensions, is growing. These quantification approaches exist, despite the lack of univocity in the definition of sustainability. This is why alternative envisioning methods, including works rooted on humanities and art-based research serve as an alternative, used also to overcome the prevalently-normative approach, used in the context of management actions and policy-making. Thus, this contribution indicates that hybrid approaches could be used, in the future, to engage with citizens and stakeholders through a balanced integration of creative reflective inquiry and normative pathways to support a transition toward more sustainable and just lifestyles assuring in this way a plurality of discourses in circular economy transition beyond the mainstream one.

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Chapter 12. Promoting a Just and Sustainable Circular Economy: The Role of Responsible Research and Innovation (RRI)

Dilay Celebi

Abstract

Despite differences in focus and means, both the CE and Responsible Research and Innovation (RRI) essentially attempt to address challenges connected to sustainable development via innovation. Regardless of the common understanding that RRI may provide an innovation governance framework to strengthen the CE framework (Inigo and Blok, 2019), there is a lack of clarity about whether and how the RRI guiding principles may be a key element of CE and be integrated in achieving a just CE transition (Pansera et al, 2019). In this section, I critically examine the literature on the CE and RRI in order to find out how the different focus of RRI may provide an innovation governance framework to strengthen the CE framework. More specifically, I critically examine the comprehensiveness, applicability, and adequateness of measurable indicators of RRI which are framed around the five keys (Strand and Spaapen, 2020), in reshaping the CE discourse to enable a fair and just transition and search for further potential indicators defined under the broader vision for RRI.

Keywords: Responsible Research and Innovation, Circular Economy, Anticipation, Inclusion, Reflexivity; Responsiveness.

How can RRI principles be effectively integrated within the CE framework to achieve a just and sustainable transition, and what are the challenges and opportunities of applying these core guidelines in the CE context?

12.1. Understanding Responsible Research and Innovation (RRI)

RRI is a concept that looks at how research and innovation can benefit society in a fair and sustainable way (references?). According to the European Commission, RRI is about thinking ahead and considering the potential effects of research and innovation on society. The goal is to design research and innovation that includes everyone and helps create a sustainable future. Under this definition, RRI is also defined by five important aspects: Ethics (doing things right), Gender (including everyone regardless of gender), Open Access (sharing knowledge freely), Science Education (promoting scientific understanding), and Societal/Public Engagement (involving the public in decision-making).

Beyond just following the rules, ethics in RRI is about understanding the broader impact of science on society. This means listening to different perspectives and making sure that science respects everyone's values. Science Education is not just about knowing science facts. RRI wants people to critically engage with science, ask questions, and participate in scientific discussions. Gender Equality is about making sure all genders have equal chances in research roles. But it goes deeper, recognizing that our understanding of 'gender' is complex and tied to other social factors like race, class, and more.

Open Access is based on the principle that if the public funds research, they should be able to see the results. This idea has grown though, and now there's a push to share not just the results, but also how the research was done. Governance is about setting goals, making plans, and checking if we're on the right track. Governance isn't just done by governments; other groups like universities and non-profits play a part too. Lastly, Public Engagement is all about involving everyone in science. Not just scientists and experts, but regular folks too. It's a two-way street: scientists share, the public gives feedback.

Different scholars have their own takes on RRI. One popular idea is called AIRR, which stands for Anticipation, Inclusion, Reflection, and Responsiveness. These are seen as important steps in the RRI process. In simple terms, RRI means that all the people involved in research and innovation need to work together and think about the consequences of their actions. It's not just about making money or advancing technology. It's about considering the bigger picture and making sure that research and innovation benefit society as a whole.

To do this, we need to look ahead and think about the impacts of new technologies, involve different perspectives, reflect on the ethical implications, and be responsive to the needs and concerns of society. It's about being responsible and thinking beyond just the short-term benefits or risks. So, RRI is a way of approaching research and innovation that puts people and the planet first. It encourages collaboration, foresight, and considering the wider impacts of our actions.

12.2 Monitoring and Advancements in RRI: The MoRRI and RRI Tools Projects

MoRRI[13] was a project conducted from 2014 to 2018 that created a monitoring system for RRI within the European Research Area (Meijer and van de Klippe, 2020). It used a conceptual framework and more than 36 indicators based on the European Commission's definition of RRI with an objective to measure various aspects of RRI.
However, the indicators developed in MoRRI faced criticism for their reliability and coverage. Some argued that they focused too much on quantitative approaches and might not capture the transformative potential of RRI. Another project called Super MoRRI[14] aimed to improve on these aspects and emphasized the need for more open evaluation activities.
The RRI Tools Project[15], supported by the European Union from 2007 to 2013, aimed to compile best practices for RRI. It established an online platform with RRI-related tools to promote dialogue and education about the concept. The RRI Tools Project defined RRI based on several dimensions, including diversity and inclusion, anticipation and reflection, openness and transparency, and responsiveness and adaptive change. These dimensions aimed to promote stakeholder engagement, ethical considerations, and adaptability in research and innovation processes.

12.3 Challenges and Progress in RRI: Encouraging Business Engagement and Integrated Approaches

Even though many experts in RRI have emphasized the importance of collaborating with businesses and private companies to make sure that research and innovation benefit the environment and society, many private companies have been hesitant to actively engage in RRI (Silva et al., 2018). This reluctance can be attributed to several factors. Firstly, the lack of a clear and well-defined understanding of RRI, coupled with the presence of similar concepts like social innovation and sustainable innovation, has created confusion within the business sector. Secondly, RRI's emphasis on scientific and technological development has sometimes led to neglecting other critical aspects, such as the commercialization of innovations. Thirdly, RRI has predominantly been applied in publicly funded research settings, with limited efforts made to adapt its principles to suit the specific needs of businesses. Additionally, businesses have often perceived themselves as targets rather than collaborators in RRI initiatives.
Despite these challenges, RRI offers a distinct approach compared to traditional Corporate Social Responsibility (CSR) models. It promotes outward-looking engagement and places significant value on the early stages of product development and research and innovation processes. RRI addresses two fundamental challenges for businesses: staying competitive in innovation and maintaining public trust. It integrates business concerns into societal challenges and can help companies prevent problems and develop solutions that benefit society. Several projects and toolkits, such as the PRISMA[16] project, aim to promote RRI in the industry by involving top management and creating a culture of responsibility throughout the organization.

[13] https://morri.netlify.app/
[14] https://super-morri.eu/from-morri-to-super_morri-monitoring-as-reflection-and-learning-not-representation-and-control/
[15] https://rri-tools.eu/
[16] https://www.rri-prisma.eu/

In an attempt to investigate how RRI concepts may be incorporated into the innovation processes of start-ups that focus on sustainability, Responsible Management of Innovation (RMoI[17]) offers innovators a systematic means to recognize and take into account socio-ethical risks and possibilities. The RMoI tool incorporates a number of stages and draws on RI, technological philosophy, and design for usability ideas. Incorporating the Product Impact Tool (PIT)[18], which draws on ideas from philosophy of technology and design for usability, the RMoI tool further develops and expands upon the principles of RRI (Long et al., 2020).

Fraaije and Flipse (2020) argue that incorporating RRI dimensions into real-world practices is challenging because people don't fully understand how these dimensions interact. They also emphasize the importance of integrated RRI, which means that while some RRI aspects can work together, others might conflict with each other. For example, more reflection might lead to more inclusiveness, but it could also create conflicts. Anticipation, even though it might face opposition from scientists wanting autonomy, can encourage more engagement. To address this, they created a framework for implementing RRI based on a comprehensive review of factors that indicate the quality of responsible processes and products. They identified five process qualifiers (transparency, inclusion, reflexivity, anticipation, and responsiveness) and three product qualifiers (societal relevance, market competitiveness, and scientific quality) for RRI. This framework helps guide the practice of RRI effectively.

12.4 Toward a Just Transition: RRI in the Circular Economy

The current concept of a CE seems to focus mainly on economic benefits, particularly for the environment, with limited attention to social aspects. Some experts, like Korhonen et al. (2018) and Kirchherr et al. (2017), highlight the need to include social goals in the CE, such as promoting the sharing economy, increasing employment, and involving people in decision-making. However, not everyone agrees on this point. The CE is criticized for not explicitly addressing social dimensions (Pansera et al., 2021). Nevertheless, there is a growing consensus that incorporating the social aspect into the CE is crucial for a responsible and fair transition. To achieve this, we need to consider a socio-technological transition paradigm, which involves significant changes in production, businesses, goods, and consumption behaviours. It's essential to assess the feasibility of these adjustments across various levels, from individuals to entire economies. Introducing RRI into the CE could be a promising way to ensure a just transition that includes diversity, inclusion, fair income distribution, employment, and working conditions.

In what follows, I thoroughly evaluate the CE paradigm within each of the AIRR dimensions, exploring how RRI can foster a fair and responsible approach to transitioning to a CE.

12.4.1. Anticipation

Looking ahead, research and innovation hold great power to shape our future. This requires us to think about the potential impacts of current research and innovation activities and to consider how they align with our principles and values. RRI involves considering the future consequences of our actions. This means asking "what if"

[17] https://www.tandfonline.com/doi/full/10.1080/23299460.2019.1608785
[18] https://productimpacttool.org/en/portal-english/

questions and being open to different possibilities. In the context of CE, it's important to systematically think about potential futures while understanding the uncertain and complex nature of CE.
RRI aims to generate positive outcomes for stakeholders, so anticipating the external environment's interaction with CE is crucial. It involves anticipating challenges, striking a balance between precaution and innovation, and collaborating with other fields to comprehensively assess the broader societal implications of CE. For example, we need to understand how CE might impact social values like privacy and equality. This requires a thorough analysis, whether through modelling or data-based approaches, to grasp the broader implications of CE.
However, the complexities and interconnected parts of the CE make it hard to predict and understand how it will affect things. Simplistic engineering models that depict CE as a linear process overlook the complexities of various markets and competition between primary and secondary goods. Connecting waste streams to inputs doesn't automatically guarantee environmental improvements. Additionally, not all CE intentions prioritise the environment, as profit-driven companies may view it as an opportunity for arbitrage. Incorporating anticipatory measures in transition to CE through RRI can shed light on forthcoming difficulties and facilitate a sustainable transition.
Yet, caution is needed when linking RRI with CE, as assuming responsible transition automatically leads to broader societal benefits is misleading. Technology creators often discover unforeseen side effects, and precautionary measures may limit innovation. Balancing precaution and innovation is a challenge.

12.4.2. Inclusion

Building trust and understanding the needs of different stakeholders is crucial for a just CE transition. This includes involving policymakers, industry representatives, civil society groups, scientists, and non-profit organisations in the transition to a CE. By involving diverse groups and addressing their specific needs, collaboration and local leadership can drive positive change.
However, stakeholder engagement can be challenging for several reasons. Interactions are often limited in scope, which may overlook important issues of power dynamics and regulations. It's also difficult to ensure representation of all groups in society, as current tools for engagement often focus on those directly impacted. This raises questions about whose opinions are included and how conflicting values are addressed. Power imbalances and governance issues can further complicate stakeholder engagement.
In the context of CE, RRI can help create a public space where different actors can debate and shape the transition process. This approach helps identify key action points and promotes informed public participation. By including stakeholders and fostering openness and reflection, the transition to a just CE can raise awareness and minimise social costs generated by conflicts between different stakeholders.

12.4.3. Reflexivity

RRI can also support a just transition to a CE by promoting reflexivity, which involves reflecting on societal circumstances, reassessing practices, and adjusting initiatives. Reflexivity helps us evaluate our efforts, understand the consequences of our actions, and anticipate unexpected events.
However, there are challenges in achieving reflexivity during the transition to a CE. The business environment that shapes the CE transition is influenced by unequal power relations, particularly through Global Supply Chains

controlled by wealthy nations and multinational corporations. These entities may prioritise their own interests and make it difficult for other stakeholders to participate fully in the transition. Additionally, evaluating which firms or projects to support in the transition is challenging, and there is a risk of exacerbating power dependencies, widening the gap between high-income and low-income nations, and neglecting actions for strong sustainability. Another risk is stakeholders becoming too focused on technical aspects of CE and losing sight of larger goals and societal implications. RRI suggests using socio-technical scenarios to encourage stakeholders to consider the consequences of their CE-related decisions. These scenarios broaden perspectives, promote reflection and learning, and foster co-evolution between technology and society.

Current CE strategies often neglect trade inequality concerns. There is a growing concern that CE is being used as a protectionist approach to gain economic advantage over other nations, rather than prioritising sustainable development. The transition to a CE can impact trade flows and resource extraction in low-income nations. While reducing resource demand can improve environmental sustainability, it may negatively affect countries relying on industries like mining, fast-moving consumer goods, textiles, and agriculture. These nations may require tailored aid programs from the international community to cope with the transition.

To achieve a just CE, international collaboration is crucial to develop equitable governance institutions and coordinate policies at different levels. Multilateral technical assistance programs should be established, especially to support low- and middle-income nations.

12.4.4. Responsiveness

Responsiveness is about institutions being open and adaptable to new knowledge, perspectives, and ideas. It means they can reflect on these and respond accordingly. In the context of RRI, it's believed that societal challenges can actually be opportunities for positive change. By discussing and defining the right impacts and processes, we can use innovation to bring about social and economic benefits.

When it comes to the CE, responsiveness involves being adaptable to changing factors and immediate impacts. It also means considering the larger systems at play and being mindful of potential misconceptions and challenges. By being responsive, we can navigate the complexities of the CE and work towards positive social and economic change.

Yet, there's a debate about how to make CE more responsive. The question is whether the transition process can be flexible enough to consider changing factors and immediate impacts. While anticipating different scenarios and having open discussions through RRI is important, there's a concern that these discussions may only serve to justify decisions that have already been made, rather than genuinely considering changing the project's objectives or outcomes.

Another aspect of responsiveness is considering the larger socio-technical systems that can influence the development and spread of the CE. Understanding these systems helps us gauge how adaptable the CE can be at different stages of its development. RRI can support a fair transition to the CE by encouraging partners to be responsive and mindful of the social, economic, and environmental effects and misconceptions that may arise. Simply highlighting the benefits of CE initiatives to others may not be enough, as stakeholders may have misconceptions or even react negatively. By being exposed to possible misunderstandings and challenges, stakeholders can better understand the complexities of achieving the desired societal impacts through innovation.

12.5 RRI's Role in Addressing Inequalities in CE

In the journey towards a CE, addressing inequalities is paramount. RRI offers a framework to ensure that the transition to CE is equitable, considering environmental, labor, and gender inequalities.

12.5.1. Environmental Inequality

When we think about the Circular Economy (CE), we need to make sure it's fair for everyone, everywhere, aligning with the AIRR dimensions of RRI. Right now, the way we make and use things often leads to environmental problems, like pollution, that affect some people more than others. This isn't fair, and it happens a lot in poorer countries where a lot of the world's waste ends up.

Researchers have found that if we keep making and using things in huge amounts, even if we recycle, we're still not going to fix this problem. To really make things better, the CE needs to focus not just on recycling, but also on using less stuff and energy in the first place. This is called a 'degrowth' approach, which is part of the Anticipation dimension of RRI, foreseeing and planning for the long-term impacts of our consumption patterns.

Sometimes, the rules we make for CE can end up being unfair, just like in the old way of doing things. They can create problems both inside countries and between different countries. For example, rich countries might recycle, but they send their waste to poorer countries, causing pollution there. This isn't right, and it's a new way of being unfair. Here, the Inclusion dimension of RRI calls for involving diverse stakeholders from all countries in the decision-making process, ensuring that the voices of those affected by these policies are heard and considered.

But, if people who care about fairness and the environment get involved, they can use CE to help fix these problems. It can be a way to make things better for both people and the planet. This approach reflects the Reflexivity dimension, encouraging us to continually assess and adjust our actions in CE to ensure they are just and sustainable.

We also need to think about how our actions in the past have hurt other countries, especially poorer ones. The CE should help fix this by being fair to these countries. This means listening to the people there and understanding how they use and recycle things in their own ways. Responsiveness, another RRI dimension, requires us to adapt our strategies in CE based on the feedback and needs of these communities.

In the CE, everyone who works, whether they get paid or not, should have a say, especially those in poorer countries. Their knowledge and ways of doing things, like recycling and reusing, are important for a fair CE. Inclusion, again, emphasizes the importance of diverse perspectives in shaping CE policies and practices.

Making CE fair means looking at who must pay the costs of changing to this new way of doing things. We shouldn't make some people or countries pay more than their fair share. This consideration falls under the Reflexivity and Responsiveness dimensions, where we must be alert to the consequences of our actions and ready to make necessary changes.

It's also about making sure everyone has a say in how we do CE. This means that people who are often left out or ignored, like those in poorer countries, should be part of making decisions. They should be able to share their ideas and have them taken seriously, aligning with the Inclusion principle of RRI.

The way people see CE can be different depending on who they are. For some, like environmental groups, it's about making life better for local communities and protecting the environment. For others, like some governments and companies, it might be more about making money and growing the economy. Recognizing these different perspectives and finding a balance is a key aspect of Reflexivity in RRI.

An important part of CE, especially in poorer countries, is people who collect and recycle waste. They do important work, but often don't get the respect or pay they deserve. A fair CE needs to really think about these people, understand their work, and make sure their needs and ideas are part of the plan. This is where the Responsiveness dimension plays a crucial role, ensuring that the CE adapts to acknowledge and integrate the contributions of these vital yet often overlooked workers.

12.5.2. Labor Inequality

The shift towards CE can significantly impact the job market. While it may create new opportunities in green industries, it can also lead to job losses in traditional sectors. RRI in the context of CE should advocate for policies that support workers during this transition. This includes retraining and education programs to help workers from declining industries adapt to new roles in the CE.

In thinking about labour and jobs in the CE, we often miss some important points. Most of the time, when people talk about jobs in CE, they only talk about how many jobs there are, not whether these jobs are good or bad. They don't talk much about things like how much these jobs pay, how long people must work, if the work is safe, or if workers have protections like unions.

Also, we don't hear much about the workers themselves, especially their own choices and power, how CE changes affect unpaid work often done at home, or the role of workers who come from other countries. Plus, issues like fairness for all genders, racism, and how some countries control others are usually left out.

Job quality in the new CE industries is crucial. The aim should be to create decent, safe, and fulfilling jobs. For example, if new recycling methods are introduced, they should be designed to be safe for workers, reducing health risks and ensuring fair wages and working conditions.

It's also important to realize that moving to CE doesn't change every job the same way. Some jobs might involve lots of physical work or machines and these don't all create the same number or kind of new jobs. For example, some jobs might be short-term or not pay very well, while others might be better in these ways.

Labor inequality also has a global dimension. CE can influence global supply chains, affecting labour markets in different countries differently. Developed countries might move towards high-tech recycling industries, while developing countries might become centres for labour-intensive recycling work.

To ensure fairness for workers in the CE, it's crucial to consider various factors, aligning with the AIRR approach. We need to anticipate how jobs will evolve, focusing not only on the number of jobs but also on their quality, including aspects like wages and working conditions. Inclusion in decision-making is key; every worker should have a voice in these changes, especially those engaged in unpaid work, workers from other countries, and individuals facing issues like racism. It's also essential to practice reflexivity by continually assessing whether our expectations about jobs in CE match the reality and being prepared to adjust our strategies accordingly. Finally, responsiveness is vital; if we find that the changes in CE are not benefiting everyone equally, we must be proactive in improving the situation, keeping in mind the global workforce's needs and challenges. This approach ensures that workers in all countries are treated equitably: anticipating the impacts of supply chain decisions on labour practices worldwide, including diverse stakeholder perspectives in these decisions, being reflexive about the consequences of these practices, and being responsive to the need for adjustments to ensure fair and equitable treatment of workers globally.

12.5.3 Gender Inequality

When we talk about gender in CE, it's not just about women. Gender means all the roles and expectations that society has for people, and these can affect jobs and how much we value different kinds of work. Women, who come from all sorts of backgrounds and have different experiences, often end up in jobs that are less valued or not paid at all, especially in work related to taking care of others or the environment. This happens in CE too.

Gender issues are connected to how we think about what's valuable. Usually, making and selling things is seen as important, while taking care of people and our surroundings is not given much importance. This is a big problem when we talk about fairness for all genders.

Experts in FEE tell us that our economy's growth is based on a lot of important but undervalued work, like taking care of others. They say we should think about wealth differently - not just as making more things, but as taking care of each other and our planet (Martinez Alvarez and Barca, 2023).

In CE, we often don't think about how different genders might be affected differently, both in making things and in using them. To make CE fair for everyone, we need to change how we think about what's valuable. We should value both paid work and the unpaid work, like taking care of family or the community.

To make CE fair for all genders, we shouldn't just try to get more women into jobs that are all about making money. Instead, we should make CE about caring - linking together the work that makes money with the work that's about taking care of things and people.

This idea aligns well with the AIRR approach in RRI. Firstly, it involves looking ahead (Anticipation) by considering how the CE will impact men and women differently, ensuring fairness in its outcomes. Secondly, it requires including everyone (Inclusion) to ensure that people of all genders are involved in decision-making processes within CE. Thirdly, there's a need for constantly thinking about our actions (Reflexivity) – this means regularly assessing whether our actions in CE are equitable for all genders and being willing to make necessary changes. Lastly, being ready to change (Responsiveness) is crucial; if we identify aspects of CE that aren't fair for all genders, we must be prepared to adjust our strategies to foster greater fairness and inclusivity.

12.6 Conclusion

In the journey towards a CE that truly benefits society and the environment, RRI plays a pivotal role by embodying the principles of anticipation, inclusion, reflection, and responsiveness. It goes beyond simply following rules; it's about embracing ethics, promoting gender equality, sharing knowledge openly, encouraging scientific understanding, and involving the public in decision-making. RRI is about putting people and the planet first, fostering collaboration, foresight, and a holistic perspective.

In the context of the CE, RRI introduces a socio-technological transition paradigm. This paradigm acknowledges the need for significant changes in production, business practices, goods, and consumption behaviours. By incorporating RRI into the CE, we can ensure a just transition, promoting diversity, inclusion, fair income distribution, employment, and working conditions. Each dimension of the CE—Anticipation, Inclusion, Reflexivity, and Responsiveness—offers a unique lens through which RRI can foster a fair and responsible transition. Anticipation encourages us to think about the potential impacts, understand uncertainties, and anticipate challenges. Inclusion calls for diverse stakeholder engagement, addressing power dynamics and conflicts, while Reflexivity prompts us to reassess practices and consider unforeseen consequences. Responsiveness is about adaptability and using innovation to address societal challenges. It involves navigating complexities, considering changing factors, and avoiding misconceptions. By encouraging partners to be responsive and mindful, RRI can help stakeholders better grasp the complexities of achieving desired societal impacts through innovation.

In summary, a just transition to a CE is the process of moving to an economic system that is fair and sustainable and takes into account the needs and rights of all stakeholders. RRI principles can help make a just transition to a CE by making sure that the transition is socially responsible, inclusive, anticipatory, reflexive, and takes into account the needs and values of all stakeholders by promoting reflexivity, addressing power imbalances, considering societal implications, and fostering international collaboration. By addressing these challenges, we can strive for a CE that is equitable, sustainable, and beneficial for all.

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Chapter 13. The Link between the Sustainable Development Goals and the Circular Economy on the African continent

Katharina Gihring, Sally-Anne Käsner and Sam Timson

Abstract

In 2015 all United Nations member states adopted the 2030 Agenda for Sustainable Development including the Sustainable Development Goals (SDGs). Concurrently new economic concepts such as the Circular Economy (CE) have gained traction counteracting the current linear economy. However, the CE has been rather resource focused e.g., waste management especially from a GN perspective. The research question this chapter addresses is: To what extent can the CE contribute to the achievement of the SDGs in Africa, especially those with a social focus? To better understand the current landscape of literature concerning the ties between the CE and the SDGS a bibliometric analysis was conducted. It is apparent that the topic of SDGs and the CE is also receiving increasing interest in Africa; however, the number of scientific publications produced in this region drastically lags behind those of the GN. Additionally, SDGs with previously weak or no link to the CE are further discussed, demonstrating that the CE can support the achievement of these SDGs as well (3, 5, 10, 11 and 16). We argue that the CE can be used as an overarching framework to achieve most SDGs.

Keywords: SDGs, CE, Sustainable well-being, Africa,

This contribution investigates the links between the circular economy and the Sustainable Development Goals in particular for the African continent, critically questioning both concepts and discussing how the circular economy can further contribute to achieving all Sustainable Development Goals.

13.1 Introduction

In 2015 all United Nations (UN) member states adopted the 2030 Agenda for Sustainable Development (United Nations General Assembly, 2015). At its core, the Agenda aims to create peace and prosperity and build a sustainable future for all people and the planet, now and for the future, targeting the most pressing global challenges of climate change and social inequalities. To achieve the Agenda, 17 ambitious Sustainable Development Goals (SDGs) with 169 targets were developed (**Figure 13.1**). All member states of the UN, 193 of the total 195 countries have signed the Agenda (United Nations, 2015).

Figure 13.1 Sustainable Development Goals and their overarching aims. Graph from *(United Nations, n.d.)*.

Simultaneously with the adoption of the SDGs as global development framework, alternative economic concepts such as bio-economy, green economy and CE have come to the forefront (D'Amato et al., 2017). Some of these economic concepts have been discussed since the 1960s (Boulding, 1966), to counteract the current linear economy of resource extraction, manufacture, use and disposal. The linear economy has led, and is leading, to the overshoot of planetary boundaries and adverse impact on society (Fanning et al., 2021). This chapter will examine and contribute to existing literature around the connection between the SDGs and the CE focusing on the African context from a social perspective.

13.2 Literature review

The hope is that a change in our current economic activities and transitioning towards a CE will support the achievement of the SDGs. However, the different economic models have various foci, from nature-based solutions, development and usage of bio-based materials to replacing fossil-fuel based materials and new circular business models to name a few examples (D'Amato et al., 2017; Korhonen, Honkasalo, et al., 2018; Lewandowski, 2018). These new economic concepts are still being shaped by different stakeholders, which is also the case for the CE.
The CE has received increasing attention by the private sector throughout the last years (Homrich et al., 2018; Kirchherr et al., 2023; Korhonen, Nuur, et al., 2018). On policy level it is actively being built into strategies, roadmaps, action plans, policies and legislation such as the rules promoting the repair of goods (European Commission, 2023) and Extended Producer Responsibility[19]. The CE is regenerative and restorative by design, where products and services are designed from a life-cycle perspective (from production to end-of-use), waste and pollution is, as much as possible, designed out (e.g., reusable containers instead of single-use packaging), resource use is minimised and natural systems are regenerated (Andersen, 2007; Braungart et al., 2007; D'Amato et al., 2017; Ellen MacArthur Foundation, 2013). Systems thinking is at the core of the CE where, for example, the agricultural sector cannot be seen in isolation from the water cycle or the manufacturing sector. This makes the achievement of a CE highly complex, because our global economy is a web of interconnected networks and changing one thread of the web will have knock on effects or shifting of burdens in another part, if not carefully implemented.
There are multiple reasons to better understand the link between the SDGs and the CE. Firstly, it is crucial to streamline processes to avoid having conflicting strategies, action plans and policies in place, that might duplicate efforts, oppose one another or enhance a silo approach in the private and public sectors around the SDGs and CE. Policy makers and other key stakeholders do not have the time to fully immerse themselves in all the different concepts hence it is important to create linkage. Secondly, it is important to extend the link between CE and SDGs beyond SDG12 (responsible consumption and production) alone, because we need to develop harmonised metrics that combine the progress in both areas and that accurately measure progress and help us to understand impact going beyond a decrease in greenhouse gas (GHG) emissions. Thirdly, limited resources be it financial, human capital and time are a serious constraint for emerging economies, which are also asked to participate in a green transition, may it be bio-based and/or circular, and the achievement of SDGs. Emerging economies are in different positions to so-called *developed*[20] countries, which is not necessarily always a disadvantage, because these countries can leapfrog and avoid making the same mistakes as developed countries e.g., technological lock-in. However, it requires different and more systemic efforts to address challenges such as high-unemployment rates, poverty, inequality, urban migration, loss of biodiversity, provision of basic human needs, and the keyword here is simultaneously. Away from a silo approach, towards a systems approach. It also requires a different perspective, keeping in mind that we are all influenced through our upbringing, culture(s), experiences and environments. This should also open up the discussion if emerging economies need to fit into a framework like the SDGs, which can

[19] "Extended Producer Responsibility (EPR) as an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. An EPR policy is characterised by: the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities; and the provision of incentives to producers to take into account environmental considerations when designing their products. (OECD, n.d.)"
[20] A developed country is defined as a 'country with a lot of industrial activity and where people generally have high incomes'(Cambridge Dictionary, n.d.). However the definition does not speak to wellbeing factors such as satisfaction, intact environment, independence.

be viewed as a (neo)liberal concept that still supports the notion of 'traditional' economic growth, and which does not speak to (international) power relations, or structural challenges of poverty, nor does it embed economic activities deeply into ecological processes (van Norren, 2020).

This chapter invites the reader to dive into the linkage between the CE and the SDGs focusing on the African continent, while also posing critical questions. The research question of this chapter addresses is, "To what extend can the CE contribute to the achievement the SDGs in Africa, especially those with a social focus?"

Many see sustainability as the umbrella concept and acknowledge that the CE has, thus far, been rather resource and waste focused, merely including the social dimension often only in the context of the number of jobs created (Guillibert et al., 2022), even though the concept is regenerative at its core which should include human well-being. This is a challenge to the African continent considering that unemployment and underemployment, energy price shocks, failure and lack of development of critical infrastructure, water and food crises (The World Bank, 2023; World Economic Forum, 2019) are only some of the most pressing challenges that affect the fulfilment of fundamental human needs (FHNs) such as subsistence, protection, affection, participation, understanding, idleness, creation, identity, and freedom. (Max-Neef, 1991). Sub-Saharan Africa (SSA) has the youngest and fastest growing population worldwide (United Nations Department of Economic and Social Affairs Population Division, 2022). The narrative of a rising middle class (Melber, 2022) has also stirred the interest of multinational corporations to further expand on the continent giving rise to companies like SHEIN, which is not a fast fashion but real-time fashion[21] company. However, the required infrastructure, skills and resources are not in place to deal with the negative impacts of waste generated from overconsumptions. In the case of SHEIN, it is driving an unsustainable and wasteful fashion industry. Africa is also still in the grip of neo-colonialism and neo-imperialism, for which its raw minerals and arms trade are good examples (Wilczyński, 2021). Thus, rethinking how Africa is structuring its economies are key in preventing lock-ins and the acceleration of a linear economy on the continent.

13.3 Methodology

To better understand the current landscape of literature concerning the ties between CE and the SDGS a bibliometric analysis on the Scopus database using R studio and the web-based interface Biblioshiny for Bibliometrix (version 3.3.0) was employed. The initial data collection took place on 23/05/2023 whereby the authors used the following search string: "Sustainable Development Goals" and "Circular Economy" focusing on literature in English. The authors agreed to only search title, abstract and keywords for "Sustainable Development Goals" and "Circular Economy" to avoid irrelevant papers that made passing comment on these terms. Additionally, the search was confined to post 2016 as an already existing paper by Geissdoerfer et al. (2017) employed a similar research method for literature preceding 2017. However instead of searching for sustainability and CE as it was the case for Geissdoerfer et al. (2017), this research focused on CE and the SDGs. The results of this initial search string were then further refined within Scopus to literature produced within or collaborated on, by African countries. Additionally, the authors attempted to further refine the scope by searching Scopus for the specific countries within Africa that had produced literature on the subject, however this gave incomplete results, likely because the relevant papers did not include geographical locations (country level) within their title, abstract or keywords.

[21] Real-time fashion also called ultra-fast fashion has even a shorter turnaround time of producing fashion compared to fast-fashion and can react to current customer demands and trends by monitoring social media. (Commons Teams, 2023)

Secondly, the authors looked at the progress towards the SDGs and then the CE before looking at both concepts jointly. CE practices that were considered as having a weak or no link in supporting the SDGs according to Schroeder et al. (2019) were further discussed within the African context.

13.4 Results

13.4.1 Bibliometric Analysis

Using the above methodology, Scopus returned a total of 764 papers between the years of 2017 and 2023 that concerned SDGs and CE. Literature produced on the topic grew at an annual rate of 59%. A 38% international co-authorship amongst 88 different countries was also detected. Countries that had a strong publication output around the search string were China, India, Australia, Europe, North America and Brazil (**Figure**).

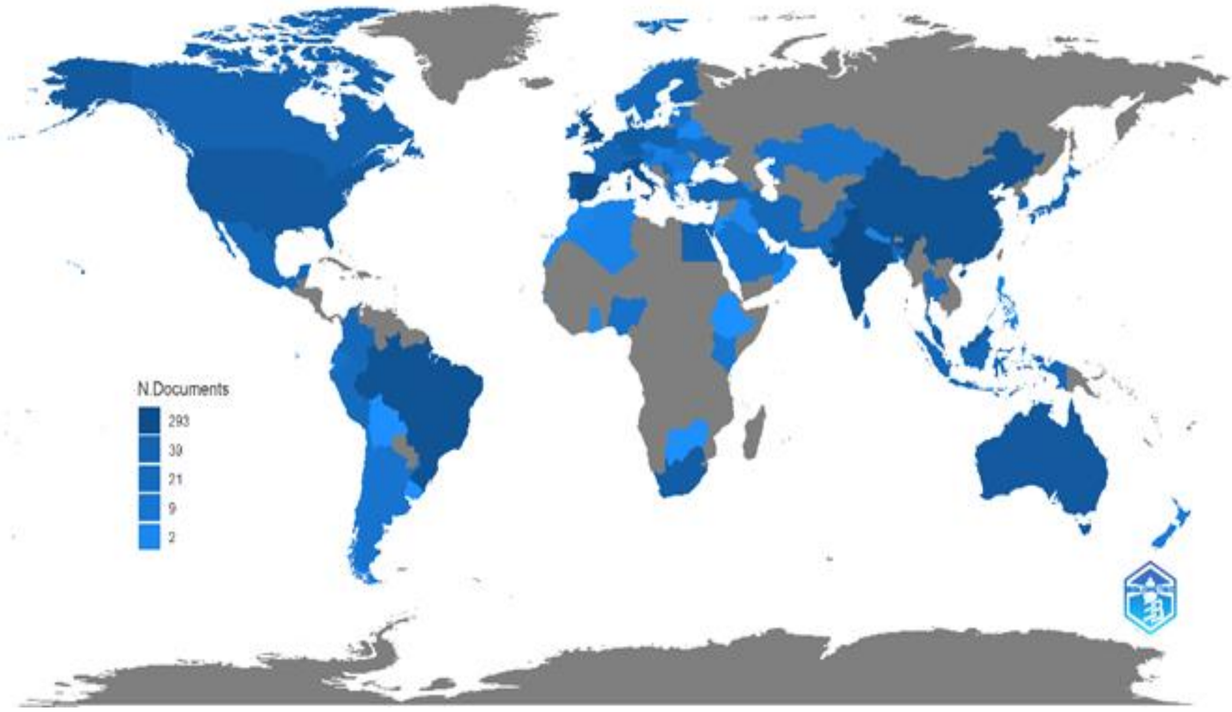

Figure 13.2 The map illustrated global publication of literature concerning CE and SDGs. Graph generated by Biblioshiny

Using this initial dataset, the authors further limited the papers published in Africa. This resulted in 68 papers from 13 African countries, namely: South Africa, Zimbabwe, Botswana, Egypt, Ghana, Malawi, Nigeria, Tunisia, Ethiopia, Gambia, Mauritius, Morocco and Kenya. Similar to the global dataset, the topic of SDGs and CE grew at a 41% annual rate on the continent and a 66% co-authorship rate.

Table 13.1 Number of global and African publications concerning SDGs and CE since 2017 until May 2023.Source: Authors

Year	Number of publications globally (Including Africa)	Number of African publications
2017	8	0
2018	23	0

2019	47	4
2020	109	8
2021	190	13
2022	256	27
2023 (until May)	131	16

The most fruitful international collaborations were between Egypt and the UK (9), South Africa and the UK (6) and South Africa and India (4) (**Figure**).

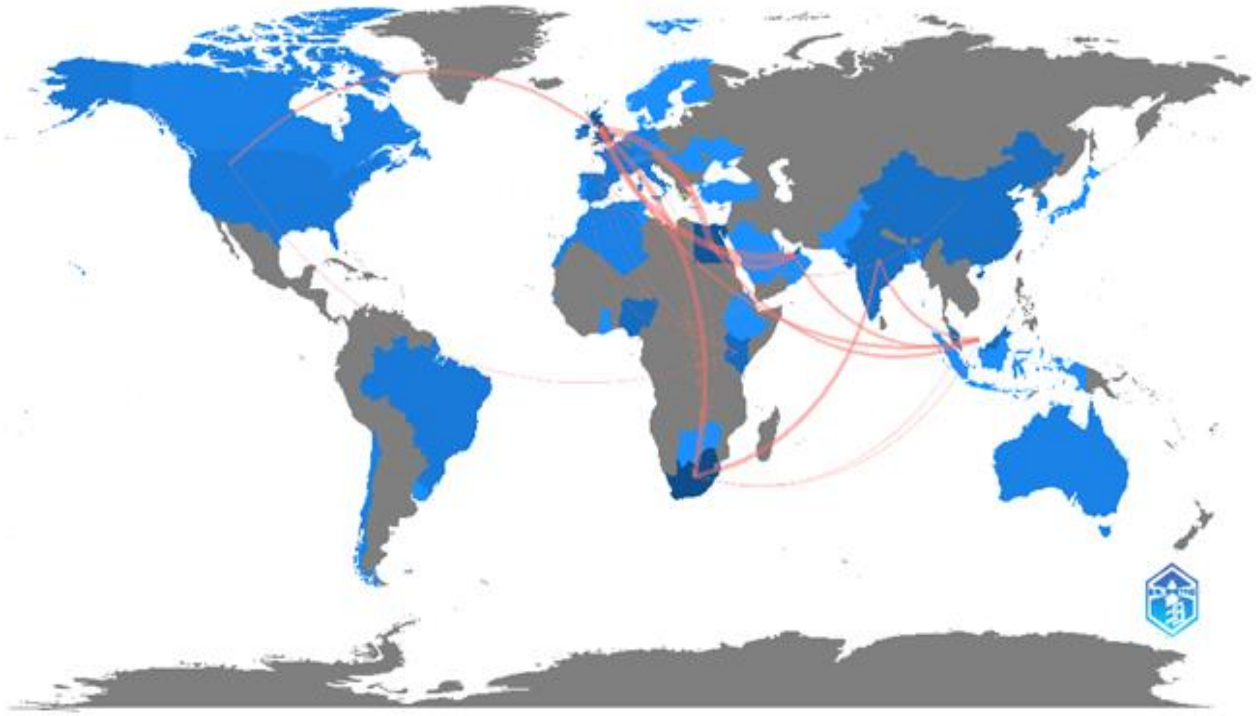

Figure 13.3 International collaboration between African countries and the rest of the world regarding publications on CE and SDGs. Graph generated by Biblioshiny

While the results of the above search string are encouraging, of the hundreds of papers above, only nineteen on Scopus were found to contain "Africa" in the abstract, in conjunction with SDGs and CE. Although the authors identified numerous papers not included in the Scopus databases (Boon & Anuga, 2020; Desmond & Asamba, 2019; Furlan et al., 2021; Naidoo et al., 2021; Wright et al., 2019)
that matched the initial search inquiry, it nevertheless illustrates the deficiency of scientific literature concerning CE and SDGs in an African context. To the knowledge of the authors additional grey literature exists (Chatham House et al., n.d.; Godfrey, 2021; Schröder & Raes, 2021) which also links Africa, CE and SDGs. Additionally, while several European countries as well as the EU have begun creating CE roadmaps and/or action plans at a national level (UNECE, 2021), the scientific literature concerning Africa indicates that the focus remains on localised initiatives or targeted towards specific industries such as waste management. Specific African countries have

already developed or are currently developing CE action plans and/or roadmaps[22]. It would be a good exercise to further investigate how national CE roadmaps and/or action plans have been linked to SDGs, if at all.

13.4.2 Progress towards SDGs in Sub-Saharan Africa

Currently, the progress of each country towards the SDGs is measured by an SDG index score which allows countries to be ranked towards the achievement of all SDGs based on annual reports submitted by the countries (Sachs et al., 2022). However, the index does not take into account the simultaneous achievement of the SDGs and measures each SDG on its own. Further, the targets attached to each SDG are not always quantifiable and, in some instances, can be ambiguous (van Vuuren et al., 2022). Hence, a target space with limited indicators has been proposed (van Vuuren et al., 2022). Despite this limitation, the SDG index score gives a good indication of where countries are at with their respective development towards achieving the SDGs. The SDGs index scores has a large range in Sub-Saharan Africa (SSA). The Republic of Cabo Verde has the highest SDG index score with 68.4 amongst SSA and is ranked on place 89 globally. The country in SSA with the lowest SDG index score is South Sudan with 39.05 which ranks it in last place globally. (Sachs et al., 2022)[23].

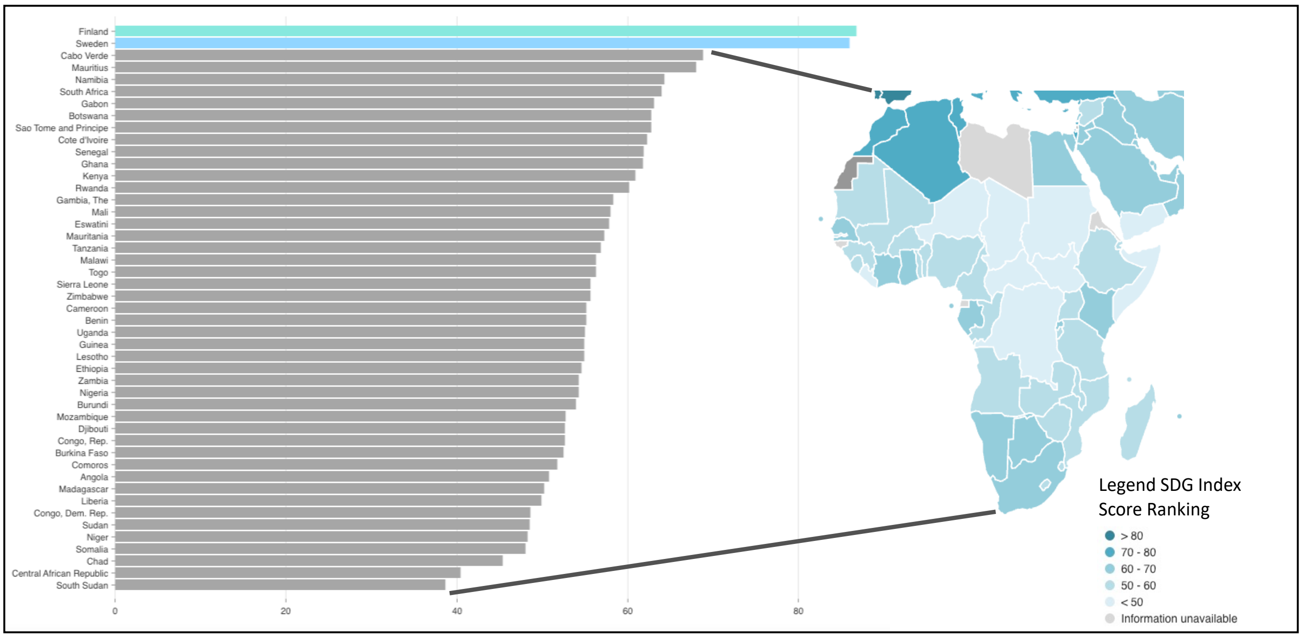

Figure 13.4 Overall index score for SSA on the achievements towards all SDGs. The closer a country is to an index score of 100 the closer it is to fully achieve all SDGs. Finland and Sweden were added as these countries reach the highest SDG index score in 2022. No data is available for Equatorial Guinea, Eritrea, Guinea-Bissau and Seychelles. Graph created from *Sustainable Development Report (2022)*.

[22] Rwanda, Ghana and Kenya.
[23] There are 30 countries for which no SDG index scores could be calculated.

Looking at the individual SDGs it shows a particular trend across SSA namely that most countries are making progress and are beginning to achieve SDG 12 (Responsible consumption and Production) and 13 (Climate Actions). That being said, SDG 12 and 13 are measured with very limited indicators. One indicator is measuring the generation of municipal solid waste (kg/capita/day), which is rather low in most SSA countries (United Nations Environment Programme, 2018) due to the limited buying power but also the inconsistency of measuring waste generation if measured at all. However, waste collection rate and accessibility to waste management services are not included as indicators, but might be more applicable to the continent. Additionally, large data gaps exist for individual countries on specific indicators, which makes measuring any trends near impossible. For most countries significant or major challenges still remain around the social SDGs[24], such as eradication of poverty, zero hunger, gender equality, peace, justice and strong institutions.

The annual sustainable development report presents the SDG index and information on a country level can be explored online.

13.4.3 State of Circularity in Africa

Chapter 21 elaborates on the current state of circularity in Africa. A brief summary is presented in this chapter. Firstly, circularity practices are deeply embedded in Africa (GRID-Arendal, 2021; Käsner & O'Carroll, 2020a), even though frequently not named as such. Secondly, Africa has an opportunity to transition to a CE from a lock-in perspective, because the continent requires major development, it can learn from the past mistakes of the GN and leapfrog some of the approaches, policies and innovations by making these applicable to each African context (GRID-Arendal, 2021; Rademaekers et al., 2020). Thirdly, policy and strategy development are underway that either link or are directly focused on transition to a CE nationally or in specific sectors (GRID-Arendal, 2021; Käsner & O'Carroll, 2020b). Despite that, the circular transition is underway; however, a lack of finance (Schröder & Raes, 2021), silo thinking, different concepts and measurement tools, lack of government support and understanding of the concept beyond resource and waste management are a few of the barriers that are slowing down a systemic transition on the continent (GRID-Arendal, 2021).

13.4.4 The links between Sustainable Developments Goals and the Circular Economy

Schroeder et al. (2019) conducted a study that investigated the general links between the 169 SDG targets and the CE. The study has been summarised based on the SDGs (**Figure 13.5**) and not the individual targets, as targets that define the SDGs fell into different assessment categories that were applied. Strong links exist between a CE and in particular SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 15 (Life on Land) (Schroeder et al., 2019). The CE will indirectly impact the achievement of SDG 1 (No Poverty) and SDG 2 (Zero Hunger) and SDG 14 (Life Below Water) (Schroeder et al., 2019). Accelerating the CE will be done by achieving SDG 4 (Quality Education), SDG 9 (Industry, Innovation and Infrastructure), SDG 10 (Reduced Inequalities), SDG 13 (Climate Action), SDG 16 (Peace, Justice and Strong Institutions), and SDG 17 (Partnerships for the Goals) (Schroeder et al., 2019). Weak to no links between the CE and SDGs were determined for SDG 3 (Good Health and Well-being), SDG 5 (Gender Equality), SDG 10 (Reduced inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 16

[24] SDGs 1 to 11 and 16 and 17 can been seen as SDGs that are linked to the social dimension.

(Peace, Justice and Strong Institutions) (Schroeder et al., 2019). For all SDGs except for SDG 9 (Industry, Innovation and Infrastructure) and 16 (Peace, Justice and Strong Institutions) cooperation opportunities exist based on included SDG targets that speak to partnerships that can enhance the CE transition (Schroeder et al., 2019).

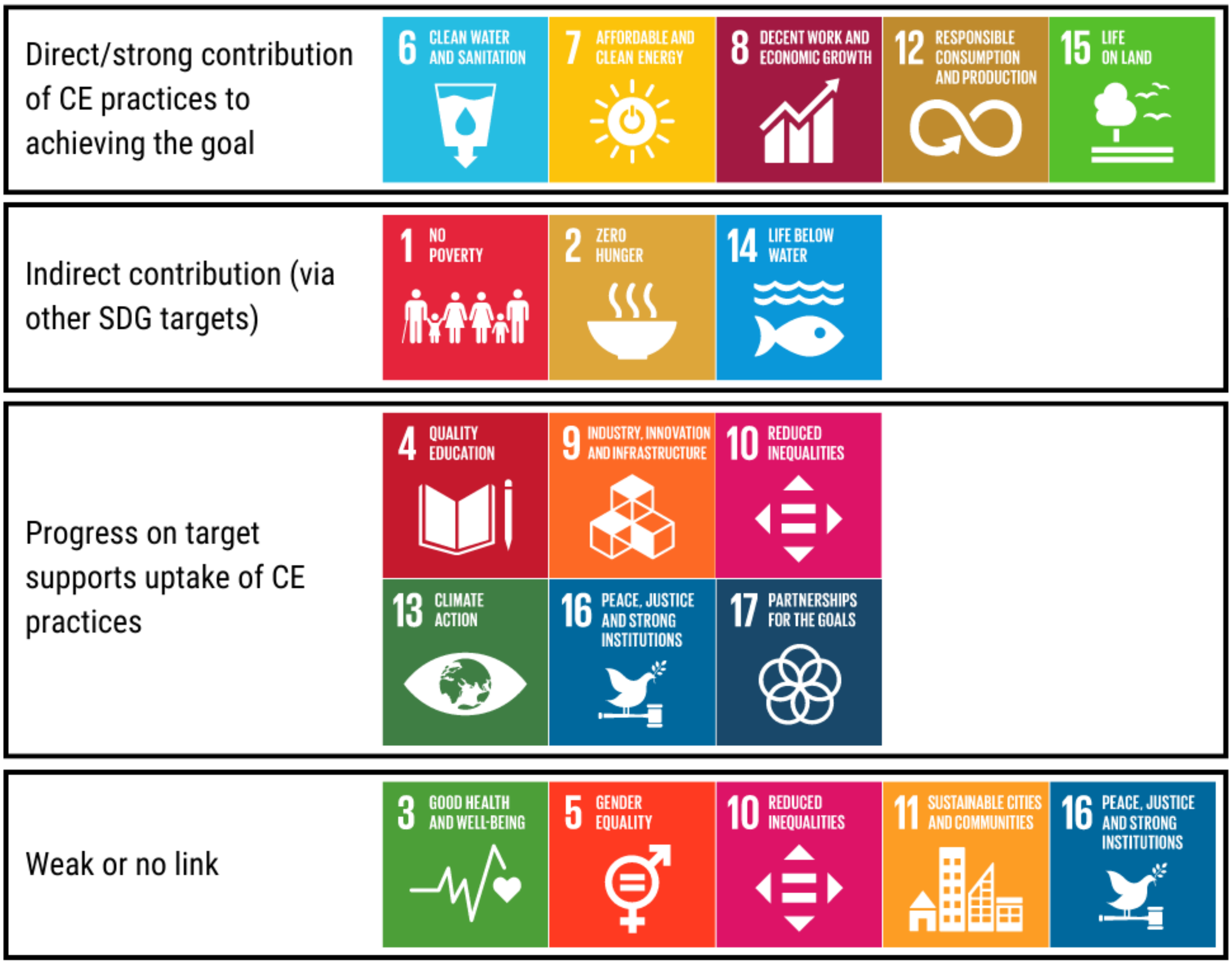

Figure 13.5 Linkage between the CE and SDGs. The figure illustrates only the main linkages of each assessment category, however SDGs can fall into multiple categories because of multiple targets each SDG is underpinned by. The assessment category cooperation opportunity to promote the CE was not included. The graph is based on the findings *of Schroeder et al. (2019)*.

The definition of the CE plays a major role on how we understand its contribution to achieving the SDGs. In Schroeder et al. (2019) the CE definition[25] was taken from the European Environment Agency and was only resource focused. However, definitions that are more inclusive of sustainable development as an aim of the CE have become more frequent (Kirchherr et al., 2023). It would be counter-productive to assume that there will be one single definition of the CE because any definition should fit and evolve with the context, but simultaneously one needs to

[25] "The concept can, in principle, be applied to all kinds of natural resources, including biotic and abiotic materials, water and land. Eco-design, repair, reuse, refurbishment, remanufacture, product sharing, waste prevention and waste recycling are all important in a circular economy."(European Environment Agency, 2016)

be aware of circular washing, the new green washing. For us, a just CE is regenerative at its core and 'in the African context is envisioned as systemic, inclusive and operative at multiple scales' (GRID-Arendal, 2021, pg. 9). Hence a just transition to a CE is required which is the process 'of shifting to a sustainable and equitable economic system where the needs and rights of all stakeholders are considered' (Purvis et al., 2023, pg. 2). This is also more in alignment with the African concept of Ubuntu ('I am because we are'), which focuses on relationships between people and the relationship with nature (van Norren, 2020). Having looked at a CE definition that is more inclusive of sustainable development we have reviewed the five SDGs that either had a weak or no link according to Schroeder et al. (2019), but are absolutely crucial to the well-being of the African continent. It has to be noted though that the research was based on a literature review up to 2017 (Schroeder et al., 2019). For this chapter we cannot drill down into each target that was considered as having a weak or no link, instead this is merely meant to contribute to an ongoing discussion. Specific targets that make up each SDG have been put in brackets in below text.

SDG 3 Ensure healthy lives and promote well-being for all at all ages

SDG 3 consists of nine targets and four targets on the means of implementation[26] (MOI). In our view this can be linked to a just CE that needs to make access to timely, effective and human-cantered medical care available to decrease global mortality rates (3.1), end preventable mortality rates under five years (3.2), while preventing communicable and non-communicable diseases (3.3 & 3.4). Even though current literature is focusing on the resources side of healthcare, more circular practices e.g., healthcare technology as a service, sharing healthcare technology between healthcare facilities, digitalisation of healthcare technology, creation of refurbishment networks etc, should make healthcare in general more accessible (3.8) (Gihring & Janse van Rensburg, 2020; World Health Organization, 2018). A healthy lifestyle which includes access to drinkable water, nutritious food and enough physical exercise can support the prevention of non-communicable diseases; however, 418 million people still do not have access to drinking water (UNICEF, 2022a), while in SSA approximately 39% of households have no reliable access to food and diversity of diet is only available to 51% of the population (Fraval et al., 2019). Creating circular food systems should also support small-scale farmers in production and processing and accessing markets as well as creating circular water systems and building infrastructure that is regenerative and taking citizens needs into account, which in turn should also support SDG 3.

African indigenous knowledge systems have been disregarded when it comes to healthcare systems which are largely westernised in SSA. Additionally, accessibility to trustworthy, affordable and caring sexual and reproductive health care (3.7) is absolutely crucial on a continent where women in the age group 15-19 still have the highest birth rate, highest mortality rate (525 deaths out of 100,000 births) and the need for family planning is not satisfied (UNICEF, 2022b; World Health Organization, n.d.). Accessibility would support the transition to a just CE, where women can equally participate in socio-economic activities. Building and developing a circular manufacturing sector that supports research and innovation (3.b), while producing medical health care technology and essential vaccines would also make the continent more resilient and less dependent on the GN as it was the case during

[26] Means of implementation have been formulated for nearly all of the 17 SDGs and refer to means such as finance, trade, capacity building and/or science, technology and innovation to enable the realisation of the SDGs (United Nations Economic and Social Commission for Asia and the Pacific, n.d.).

Covid-19. A circular development approach would see all the above-mentioned sectors e.g., food, water and knowledge in an interconnected way that can positively contribute to SDG 3, where resources (e.g., healthcare staff and equipment) are efficiently managed and disease prevention is achieved by making basic human needs such as clean water and nutritious food accessible.

SDG 5 Achieve gender equality and empower all women and girls

SDG 5 consists of five targets and three targets on the MOI. The topic of gender[27] equality and the CE has been addressed in Chapter 12. So far gender equality has not been well addressed within the CE debate. It is important to note that gender equality per se will not create the required transformation, because it would include more women in the formal economy but does not address the factors that lead to devaluation of the work women mainly carry out on an unpaid basis such as reproductive, care and household work (Martínez Álvarez & Barca, 2023). SDG5 targets are strongly applicable to the African context e.g., end all forms of gender-based violence (5.2), recognise unpaid (reproductive) work (5.4) etc, however these have to go further into how value of unpaid work is being perceived and recognised in a society. Thus, values and social norms are based on and have been carried through from the linear into the current CE discussion and need to be transformed, to include 'circular work in all of its forms' (Martínez Álvarez & Barca, 2023, pg. 19; see also chapter 18 in this volume). This means the 'CE must aim at closing the loop between productive (i.e. valued) and reproductive (i.e. devalued) work' (Martínez Álvarez & Barca, 2023, pg. 19).

SDG 10 Reduce inequality within and among countries

Seven targets and three targets on MOI make up SDG 10. Reducing inequalities has been discussed under SDG 5 concerning undervalued work mainly conducted by the women. However, this can be broadened by including other groups that are discriminated against such as migrants (10.3). It comes down to reframing what we consider as value and within the CE paradigm, our norms and what we define as value should be questioned.
Further, the SDG calls for financial soundness indicators (FSI)[28] (10.5), to better regulate and monitor the global financial markets and for 'monitoring financial risks and vulnerabilities of national financial systems' (San Jose et al., n.d.). For the CE a lack of financing has been identified as a key barrier for African entrepreneurs (Chatham House et al., n.d.; Gonçalves et al., 2022; Milenge et al., 2022). Hence, different financial tools need to be developed and made available which would also require indicators. FSI would also need to be adapted to actually reframe the perceived risks of financing CE businesses in all of the different development stages and the investment the public and private sectors are contributing towards scaling the CE transition. The risk of not transitioning might be much higher than any risk measured by the FSI due to fast approaching critical resource constraints, decease in

[27] 'Gender refers to sociocultural norms, identities and relations that shape behaviours, products, technologies, environments, and knowledges. Gender attitudes and behaviours are complex, changing across time, with education, age and socioeconomic status, and are specific to cultures, religions, ethnicities, and infrastructures' (European Commission Directorate-General for Research and Innovation, 2020).
[28] 'Financial soundness indicators are indicators compiled to monitor the health and soundness of financial institutions and markets, and of their corporate and household counterparts' (Sundararajan et al., 2002).

ecosystem services which will and already is impacting human well-being. In line with reducing inequalities between countries, especially between the power imbalance between the GN and South, it is important that international trade agreements are being developed in equal collaboration with emerging countries (10.6). These agreements need to carefully navigate potential environmental and social burden shifting of a CE transition to avoid repeating the mistakes of the linear economy, which leads to environmental injustice (Meira et al., 2022, see also chapter 17 of this volume). It is crucial to consider distributional (who pays the cost of a CE transition), procedural and recognition justice (equal representation and weight of marginalised groups) in a transition to a CE (Meira et al., 2022). The African Continental Free Trade Agreement (AfCFTA) has not included the circular economy as an overarching framework. More on policies and legislation can be found in Chapter 21.

SDG 11 Make cities and human settlements inclusive, safe, resilient and sustainable

SDG 11 consists of seven targets and three targets on MOI. It can be safely argued that the CE can support the reduction of the number of deaths through disasters including water-related disasters (11.5), increase access to public spaces that are safe, green and inclusive (11.7), and usage of local materials to develop the built environment (11.c). Circular cities would create adaptive and innovative ecosystems that make use of local construction materials, and build green buildings, while utilising spaces in a city not only productively but also for biodiversity to thrive while in-cooperating human well-being aspects by making use of green corridors, food reuse schemes, repair cafés, community space etc (Williams, 2021) to foster cohesive and healthy communities. This can be well showcased by the work ICLEI - Local Governments for Sustainability is currently undertaking in 15 African cities where for example the City of Cape Town aims to build a prosperous, inclusive and healthy city for all of its citizens, while also addressing urban heat, water scarcity, and flood risks (ICLEI Africa, n.d.).

SDG 16 Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Ten targets and two targets on MOI contribute to SDG 16. A CE might not enable access to a justice system however access to a justice system would accelerate the just CE transition. A functioning and well governed justice system is crucial to develop and ratify national and international policies, which are also needed for the CE. A just CE would through technology such as blockchain enable every person having access to their birth certificate (16.9) thereby fulfilling a fundamental human right[29], which allows an individual to access proof of identity, government schemes, education, healthcare, open bank accounts and vote (Bhatia et al., 2017).
Achieving a just CE will also be supported by achieving target 16.5 (Substantially reduce corruption and bribery in all their forms) to 16.7 (Develop effective, accountable and transparent institutions at all levels) (Schroeder et al., 2019) which need particular mentioning in the African context. To enable a just CE it is paramount that transparency is not only created around resource value chains which should include transparency around labour

[29] It is estimated that a quarter of born children or 1 in 4 children under the age of 5 are not legally registered and are thus ‘invisible’ to the government (UNICEF, 2023).

conditions but also that governments are being kept accountable for investing and govern to the best interest of their communities and the global community at large. Especially target 16.5 and 16.6 need to be improved in Africa. SSA has the lowest regional corruption perceptions index (32/100 CPI) (Transparency International, 2023). Thus, corruption is one of the major barriers to create strong institutions and good governance, where a people-empowering leadership style and citizen participation are required, as is also reflected in Ubuntu (van Norren, 2020).

13.5 Discussion and conclusions

This chapter has examined existing scientific literature on the connection between the SDGs and the CE with a particular focus on Africa. From the bibliometric analysis it becomes apparent that the continent has conducted much less research regarding the topic, however the increasing number of publications demonstrate that the topic of CE and SDGs is becoming increasingly relevant, at least within the academic domain. A systematic literature review of the identified publications and adding grey literature would be recommended as the CE, like sustainability, has also attracted a lot of publications due to it being trendy and a current buzzword, leading to research that is rather recycling knowledge than contributing to new knowledge (Kirchherr, 2023). In any analysis the applied CE definition determines how much the CE can support the achievement of the SDGs, especially those with a social element. As previous applied definitions were rather resource focused, it is easy to argue that the CE cannot contribute to the achievement of all SDGs.

We argue that the CE can be used as an overarching framework to achieve the SDGs and add increased momentum to sustainable development in Africa. Throughout the chapter SDGs that were previously classified as having a weak or no link to the CE were discussed. It became apparent that the CE can in its original form of being regenerative, support also specific targets of SDGs 3, 5, 10, 11 and 16.

In the African context, the targets that make up the SDGs should be critically questioned as well as the GN focused CE definitions. It is clear that the African continent needs to raise its voice and critically assess concepts that seem novel. The CE has been practiced for decades on the continent and is by no means novel, but well ingrained in communities. A danger is that the necessary development of the continent follows the unsustainable example provided by the GN, instead of learning from the mistakes made by these countries. It is clear that development pathways as well as assessments of CE programmes and initiatives need to be specific to the continent and local agencies should not entirely follow in the footsteps of the Northern hemisphere (Melber, 2022). Even though we would recommend further research into the topic, the question that needs to be posed is how much of the scientific knowledge is being translated into actual implementation on the ground to the better well-being of Africans?

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Chapter 14. Critical analysis of Assessment methods for CE understanding and monitoring

Remo Santagata

Abstract

The Circular Economy (CE) concept is nowadays very common in scientific literature and in public discourses. It has become a prominent point addressed by politicians of every coalition and by corporate representatives, and even a keyword in advertising. However, there is no univocal definition of the CE concept, let alone a shared assessment method. Different national and international organizations, academics, and other stakeholders have proposed different assessment frameworks and related indicators for CE monitoring. In this chapter, a critical analysis of some of the proposed CE assessment and monitoring attempts is conducted, discussing indicators and perspectives adopted in CE monitoring.

Keywords: circular economy indicators; assessment methods; circular economy definition; multi-criteria assessment

Circular Economy assessment is based on the definition of circular economy adopted, which is still unclear. As a consequence, current CE indicators are mainly approaching CE from a technocratic perspective, while they should include other aspects like wellbeing and equity.

14.1 Introduction

The Circular Economy (CE) concept has gained a strong momentum in the last decades, both in the scientific community and in many other sectors of society, as governments, non-governmental organization (NGOs) and businesses (Lazarevic and Valve, 2017). The number of scientific works on CE has been growing significatively. The Scopus citation database reports 508 documents on CE in the timeframe 2000-2010, while the number dramatically increases to 24'891 documents in the timeframe 2011-2023 (19'114 results only within 2020 and 2023). Of the total 25'399 scientific works published from 2000 to July 2023, almost half (47%) identifies as subject areas Environmental science, Engineering and Energy, 8% identifies as subject area Social Sciences, 7% identifies Business, Management and Accounting. From the analysis of the subject areas, it is clear how the CE matter is approached in a strong technocratic perspective, as it is acknowledged mostly as a technological/material issue, thus calling for mostly material/technological approaches (Greene et al., 2024; Purvis et al., 2023).
As an example, this perspective is recognized within the perhaps most famous and most widespread definition of CE, from the Ellen MacArthur Foundation (EMF), acknowledging the CE as a restorative industrial economy

framework, minimizing waste and resource use. It is intuitive that indicators and methods developed and in development for CE assessment and monitoring will be influenced by the definition of CE and by the perspective adopted.

Since a general consensus about what a CE is, what it should do and represent and how it should be achieved is lacking, assessment methods and metrics tend to focus on different aspects and to emphasize different features. In this chapter, some of the most prominent definitions of CE will be reported and analysed, as well as some CE indicators and metrics, in order to understand the general, common perspective towards the CE topic, and its feasibility in addressing the issues faced nowadays by human societies.

14.2 – Circular Economy definitions

Different stakeholders, as worldwide NGOs, national and international policy makers, academics, and industry have provided some sort of definition or outlining of the CE concept. Some significant efforts in CE definition by different sources, representative of noteworthy efforts from governments, NGOs, academia and international institutions, are:

- The term "circular economy" is a generic term for the reducing, reusing and recycling activities conducted in the process of production, circulation and consumption. […] The state shall work out industrial policies in accordance with the requirements for the development of a circular economy (People's Republic of China, 2008).
- The circular economy refers to an industrial economy that is restorative by intention; aims to rely on renewable energy; minimises, tracks, and eliminates the use of toxic chemicals; and eradicates waste through careful design. […] It involves a careful management of materials flows, which, in the circular economy, are of two types as described by McDonough and Braungart: biological nutrients, designed to re-enter the biosphere safely and build natural capital, and technical nutrients, which are designed to circulate at high quality without entering the biosphere. (Ellen MacArthur Foundation, 2012).
- In a circular economy the value of products and materials is maintained for as long as possible; waste and resource use are minimised, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value (European Commission, 2015).
- The circular economy is an economic system where waste is designed out, everything is used at its highest possible value for as long as possible and natural systems are regenerated. The concept of circularity closely mimics nature, where there is no waste: all materials have value and are used to sustain life in a myriad of ways. If we effectively deploy these strategies, we will ultimately require fewer materials to provide for similar societal needs (Circle Economy, 2008).
- Circular Economy is an economic system that targets zero waste and pollution throughout materials lifecycles, from environment extraction to industrial transformation, and to final consumers, applying to all involved ecosystems. Upon its lifetime end, materials return to either an industrial process or, in case of a treated organic residual, safely back to the environment as in a natural regenerating cycle. It operates creating value at the macro, meso and micro levels and exploits to the fullest the sustainability nested concept. Used energy sources are clean and renewable. Resources use and consumption are efficient. Government agencies and responsible consumers play an active role ensuring correct system long-term operation (Nobre and Tavares, 2021)

The previous list is far to be considered complete, as scholars have identified hundreds of definitions of CE (Kirchherr et al., 2023), acknowledging it as a tool mainly aimed at economic growth (Kirchherr et al., 2017), or alternatively focused on environmental conditions (Helander et al., 2019), while social aspects seem to be underestimated. In the same perspective, most of the scientific literature couple the CE concept with waste management related principles, like the 9R framework (Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle, Recover), the Waste Hierarchy principle, upcycling, production of clean and renewable energy and resource efficiency (Nobre and Tavares, 2021).
Of course, the approach to CE definition also influences the approach to CE assessment. However, even though the mentioned definitions are from relevant and diverse bodies, the attention towards a social perspective of the CE transition remains limited or even absent. This translates in the lack of significant efforts for quantitative and/or qualitative evaluations of social features within a just CE transition.

14.3 Circular Economy assessment in a worldwide transition

Most of the proposers of the different mentioned CE definitions, also suggest some kind of metrics and indicators for the assessment of CE.
The EMF proposes a Material Circularity Indicator (MCI), aiming at defining the degree of circularity of materials involved in production processes (Ellen MacArthur Foundation, 2015). The MCI (**Figure 14.1**) accounts for flows of virgin resources, of reused or recycled resources, and of waste generated, calculating a value between 0 (least circularity) and 1 (most circularity), also accounting for the durability of products. The EMF also provides a set of businesses-oriented indicators, trough the Circulytics project, organized as 2 categories i): Enablers and ii): Outcomes, and 11 themes (Strategy and planning; Innovation; People and skills, Operations, External engagement; Products and materials; Services; Plant, property, and equipment assets; Water; Energy; Finance), for supporting the assessment of the levels of circularity within interested businesses (Ellen MacArthur Foundation, 2022).

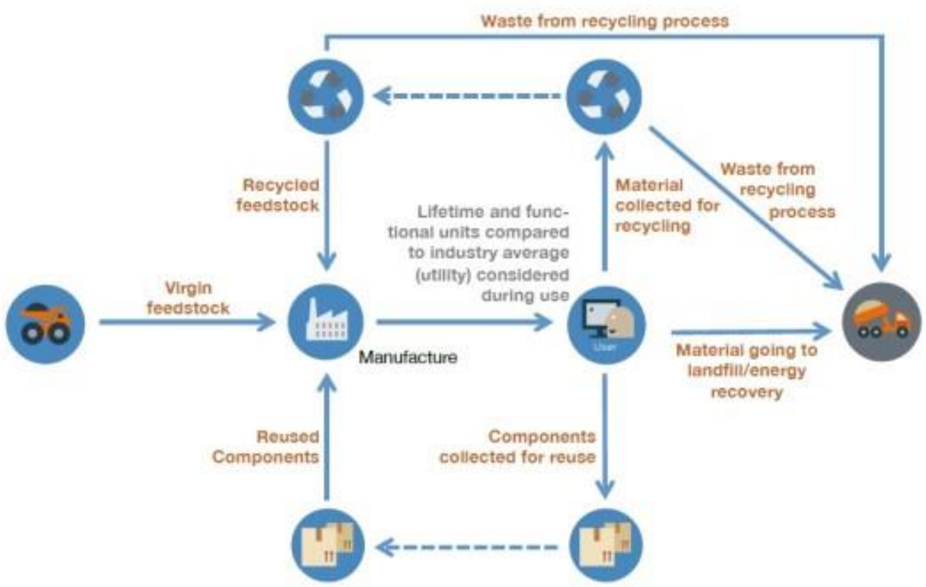

Figure 14.1The Material Circularity Indicator (Ellen MacArthur Foundation, 2015)

Similarly, the Circle Economy Foundation proposes a measure of the global level of circularity as the ratio of end-of-life materials cycled back into the global economy, in so doing reducing the need for primary resources. This metric is equal to 7.2% in 2023, in decline compared to values from 2018 (9.1%) and 2020 (8.6%) (Circle Economy, 2023). The metric is calculated through the accounting of the resource needs in different societal departments (Housing; Communication; Mobility; Healthcare; Services; Consumables; Nutrition). Through selected actions in a roadmap, they foresee a possible increase of the circularity metric to reach 17% by 2050, also mitigating greenhouse gas (GHG) emissions.

The EU proposed, in January 2018, a monitoring framework for CE, revised in 2023 (Eurostat, 2023). The EU framework includes 5 thematic areas: i) production and consumption, ii) waste management, iii) secondary raw materials, iv) competitiveness and innovation, v) global sustainability and resilience. Each thematic area includes several indicators, such as material footprint, resource productivity, consumption footprint, greenhouse gas emissions from production activities and material dependency. The monitoring framework is based on the circular economy priorities in the context of the European Green Deal, highlighting, for instance, that the number of EU-registered patents on recycling and secondary raw materials increased by 14% between 2000 and 2019; that in 2021 there were 4.3 million jobs in the economic sectors relevant to the circular economy, an increase of 11% compared with 2015. Moreover, EU GHG emissions from production activities decreased by around 25% between 2008 and 2021. However, the EU monitoring framework is deficient in indicators related to the social dimension, to the circular business models and industrial symbiosis, and to the water use, energy use and emissions, thus somehow disregarding the main elements of CE (Feiferytė-Skirienė and Stasiškienė, 2021).

From an academic/scientific perspective, many studies focus on CE from the micro (e.g., products, companies, consumers) and the macro (e.g., cities, regions, nations) levels, while the meso level (e.g., supply chains, industrial parks) is quite underexplored, even if the importance of the meso level is highly recognized (Kulakovskaya et al., 2022). In general, the importance of CE measurements is acknowledged as an important aspect to allow or to facilitate the transition to a CE framework. It is argued that CE metrics should focus beyond the common linear economy, and the infinite growth-related parameters, and should rather include other aspects, such as wellbeing and cooperation, in a multi-perspective framework (Santagata et al., 2020). The strong connection between CE and the concept of sustainability and sustainable development allows the use of several indicators for the assessment of CE implementations (Pauliuk, 2018).

The CE assessment is mainly performed by means of quantitative approaches, as the LCA and the MFA, thus adopting some or all their indicators as feasible CE metrics. These are consequently mostly related to greenhouse gases emissions, resource use, recovery and reuse of materials, use of renewable energy, emissions of toxic substances, and to other bio-physical or economical indices. In these approaches very often, socio-economic and wellbeing features are disregarded, although some methods encompassing these characteristics also exist, as for example the S-LCA method, providing information about the social effects associated with the life cycle of a product (despite still under significant development), the LCC method, accounting for all funds expended in support of an item from its conception and fabrication until the end of its useful economic life, and the Emergy Accounting (EMA), a thermodynamics-based and systems-oriented method evaluating processes from an environmental perspective and accounting for stock and flows based on their quality, embedding socioeconomic insights within the inclusion of flows of labor and services (namely, undirect labor). Also, the local/non-local dichotomy, as considered by the EMA method, could represent a protection factor taking into account the needs of local communities as part of the complex system to be acknowledged within a just transition.

Within grey literature (namely, non-academic publications), a significant number of different software tools encompassing multiple scopes and aims can be found. Several of these tools and software applications are business and material/product oriented, with an environmental perspective. Of these, the wider part tends to include one of more life cycle-related indicator (e.g., carbon footprint, resource depletion, waste recovery, etc.) (Muñoz et al., 2023). These tools also tend to mainly disregard the socio-economic aspects of CE, reflecting the largely technocratic approach of current CE definitions.

14.4 Limits and future perspectives for CE measurements

However, it is argued that these interpretations of CE raise questions regarding the validity of the assumptions embedded within the CE concept and within the never abandoned idea of infinite growth (Giampietro and Funtowicz, 2020). If, as claimed by several definitions of CE, human societies have to mimic the network of material and energy exchanges happening in the natural ecosystems, the need for a thorough anticipation by governments and science is needed, meaning an improved ability of foreseeing and anticipating the possible problems and challenges ahead. Relying only on 'invisible hand' and human ingenuity as a way to solve problem is an idea heavily tied to outdated 'more of the same' approaches typical of market-based mechanisms of the linear oriented economy frameworks, not acknowledging the new social and bio-physical constraints that are still brought up in the CE discourses and narratives, but are then guiltily and incredibly lost when indices for CE measurements are proposed.

Thus, CE measurements and indicators should go further than the indices and methods usually implemented within linear economy models (**Table 14.1**), such as GDP, revenues and market prices, among others, but should widen to include other aspects, including wellbeing, stability, equity and environmental integrity, and other networking/collaboration-oriented aspects (Oliveira et al., 2021).

Table 14.1 Features of linear and circular economy (Oliveira et al., 2021)

Linear Economy	**Circular Economy**
Business based	Network based
Stand-alone activities	Collaborative, nexus oriented
Mono–criteria (value based on maximum income	Multi–criteria (value based on selected characteristics)
Design and planning for unlimited growth	Resources are limited
Conservative (more–of–the–same approach)	Regenerative (saving resource generation patterns), flexible about pursued results
Concentration (getting more, spending less)	Redistributive (fair resource allocation)

Human societies are to be intended and acknowledged as complex systems, and as such, they follow oscillating pattern of growth and degrowth phases based on the availability of resources (Odum and Odum, 2001). The so-called pulsing paradigm (**Figure 14.2**) follows four main stages: (i) Growth: abundant resources, increases in population, structure, and assets; low-efficiency and high-competition; (ii) Climax and Transition: maximum size depending on available resources; efficiency increase; collaborative patterns; information storage; (iii) Descent:

less resources available, decrease in population and assets, increase in recycling patterns; (iv) Low Energy Restoration: no-growth, consumption smaller than accumulation, and storage of resources for a new cycle ahead. Policies and assessment methods should therefore accordingly adapt to the current situation, as well as indicators. Western societies may be on the verge of a descent (and complex) phase, and this situation needs to be correctly acknowledged.

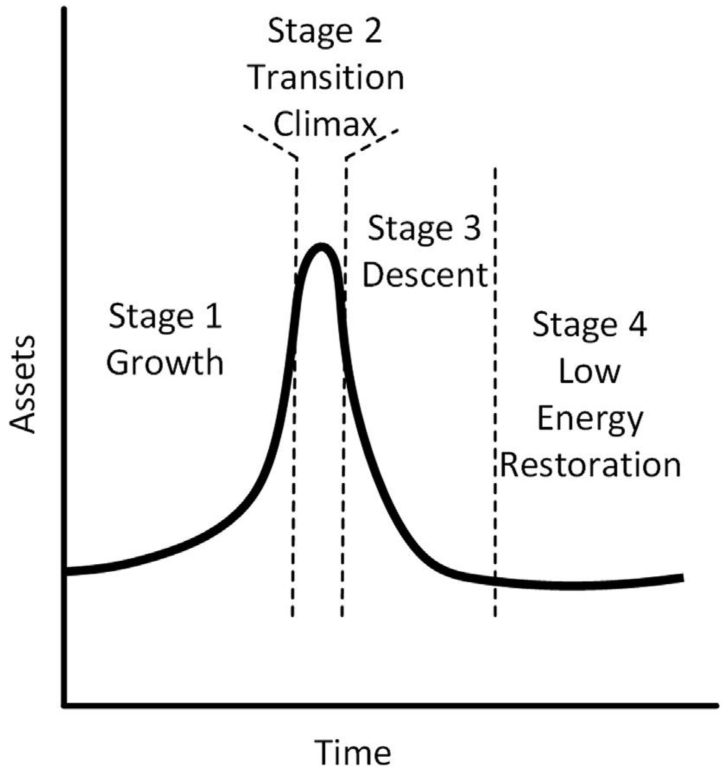

Figure 14.2 The pulsing paradigm (After Odum and Odum, 2001)

To overcome the reductionist approach of current linear economy-oriented indicators still applied to the CE framework, novel indicators are much needed, able to include the environmental dimension (conservation of natural capital, decrease of pollution, environmental protection, etc.), together with the social dimension (quality of food and education, jobs, participatory strategies, etc.), giving attention to the different kind of impacts of the alternative options within the surrounding environmental and socio-economic constraints (Santagata et al., 2020). This could be performed by the implementation and the integration of different methods, in a multi-perspective approach. This way, a holistic point of view becomes achievable, gaining a systemic understanding of problems and solutions.

14.5 LEAF: an effort for LCA and Emergy integration

Within the scientific literature, some efforts in the integration of complementary assessment methods can be found. Method integration could represent a feasible way for CE assessment by allowing a deeper multi-criteria analysis of case studies, scenarios, future plannings and implementations. In particular, several scholars investigated the potential for integration of the LCA and EMA methods, exploiting at the same time the similar way they are performed (i.e., by compiling analogous inventories of input and output energy and material flows) and the opposite perspectives adopted (the downstream, product oriented LCA point of view, and the upstream, ecosystem oriented EMA approach) (Ingwersen, 2011; Marvuglia et al., 2013; Raugei et al., 2014). A recent approach provided an LCA/EMA integration procedure, applying the two opposite perspectives to deliver a much deeper comprehension of the assessed systems. The procedure, called LEAF (LCA & EMA Applied Framework), shown in **Figure 14.3**, consists of i) an Ex-Ante LCA, identifying the hotspots within the investigated case study; ii) a number of EMA scenarios, modelled around the selected hotspots, to evaluate the performances of proposed solutions; iii) Ex-Post LCAs of each EMA scenario, to assess to what extent each proposed solution has addressed and maybe removed the hotspots identified by the Ex-Ante LCA. This way, both the environmental effects and the general sustainability and performances of different solutions are explored, starting from the most significant constraints identified (Santagata et al., 2020).

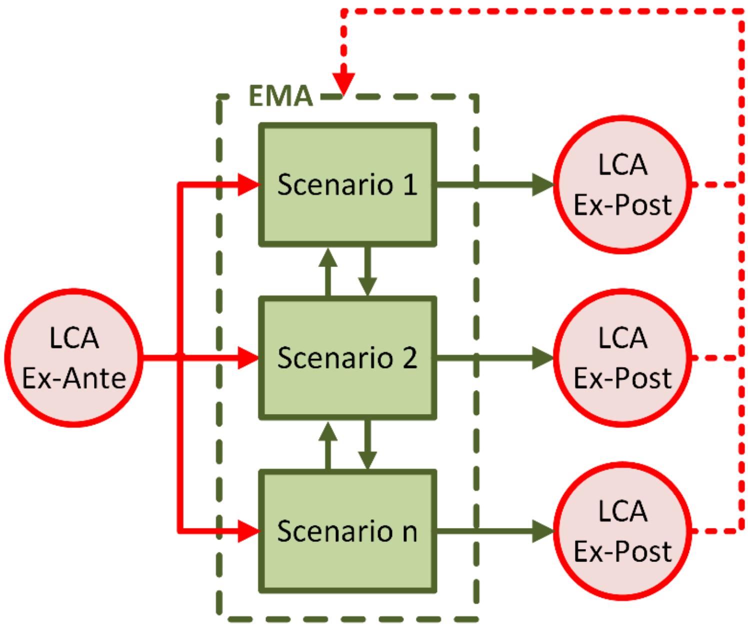

Figure 14.3 The LEAF Procedure (Santagata et al., 2020)

A multi-criteria, multi-perspective approach like the example discussed above would present the advantages of acknowledging and analysing CE features as complex systems, requiring holistic ways of study and assessment, delivering solutions capable of encompassing the so much advocated "circular aspects" needed to facilitate an equal, just and sustainable transition. The LEAF procedure seems to be capable of capturing environmental features together with socio-economic ones, the latter involved by the EMA method. Thus, the LEAF procedure represents a still improvable efforts for building new methods and indices.

14.6 Conclusions

The transition to a Circular Economy, and the implementation of CE strategies, must be capable of distancing from a reductionist, technocratic approach and have to be acknowledged as a complex system, requiring complex approaches taking into account local features and local stakeholders. Most of the current CE definitions and, consequently, indicators still fail in acknowledging that CE should not be just a technocratic matter intended to support and reinforce the old linear infinite growth delusion. Thus, the opportunity of using the need for new assessment frameworks for a new paradigm by international bodies and government should represent a chance for developing new metrics going further the simple idea of economic growth that are capable of including wellbeing, equity, environmental integrity and economic stability, in so doing ensuring, or at least facilitating, the concept of '*just transition*' that would be fair and feasible for all.

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Chapter 15. Environmental, economic and social accounting of Circular Economy

Remo Santagata

Abstract

The forthcoming CE paradigm will need metric and assessment methods to investigate its feasibility, performances, and burdens, related to the environmental, social, and economic dimensions. This chapter summarizes some of the most common assessment methods that can be implemented to achieve a widespread understanding of strengths and weaknesses of circular economy initiatives. Each mentioned method answers a specific question and is not exempt from flaws and biases. Therefore, the simultaneous application of different frameworks can result in more accurate and holistic analyses to support a fair transition. This cannot happen without a critical discussion of assessment methods, their capabilities and their vulnerabilities.

Keywords: Assessment methods, circular economy indicators, methods integration, holistic approach

The transition to a new Circular Economy paradigm will need to overcome the current lack of feasible metrics for a holistic assessment of the social, environmental, and economic features of a just transition.

15.1 Introduction

The announced transition to a CE is expected to shift the global economy from a linear paradigm, 'take-make-dispose', to a circular one, aiming for a system that would be 'restorative and regenerative by intention and design'(Ellen MacArthur Foundation, 2012). This would be achieved by implementing pathways within human driven processes and on different levels. However, CE is still far from a broad implementation as an established economy paradigm, and 'circular' applications and strategies are solely applied within the still ongoing linear paradigm.

A global-wide transition to a CE would need and benefit from a thorough assessment and planning of the actions, pathways and strategies to be implemented for their expected environmental, social and economic effects, outcomes and related implications. 'Circularity' levels have been approached and measured in different ways over the last years (Vinante et al., 2021), proposing several indices for CE assessment and adapting environmental, social, and economic assessment metrics for circularity evaluation. Nevertheless, a standardized and shared method for CE assessment is still lacking (Kristensen & Mosgaard, 2020), impacting the diffusion of policy resolutions and of the implementation of CE strategies.

Moreover, perhaps a result of the technocratic approach to CE definition, which mainly look at CE as a technologic waste disposal and recovery problem, a wide range of the studies approaching CE measurements focus on the material circularity and resource productivity, accounting for recycling, recovery and reuse of waste and materials (Bastianoni et al., 2023). Such measurements are however incapable of grasping the complexity of the CE paradigm and of simultaneously addressing the 3 pillars of sustainability: environmental, social and economic.
In this chapter, a collection of existing assessment methods suitable for CE measurements from different perspectives is reported, analysed and criticised for their pros and cons. The included metrics are acknowledged as capable of assessing CE strategies, implementations, and networks in a holistic way if performed in an 'integrated' approach, as opposed to their own linear, mono-criteria perspectives.

15.2 Material Flow Accounting

The Material Flow Accounting (MFA) method is acknowledging the law of thermodynamics on conservation of matter. Matter (mass and/or energy) is neither created nor destroyed in transformations. Thus, the relation between the economy and the environment embedding it (**Figure 15.1**) is expressed as a balance between the input matter and the output matter plus accumulation in stocks within the economy (European Communities, 2001). The MFA method thus evaluates the material balance and the performance of the socio-economic metabolism (SEM).

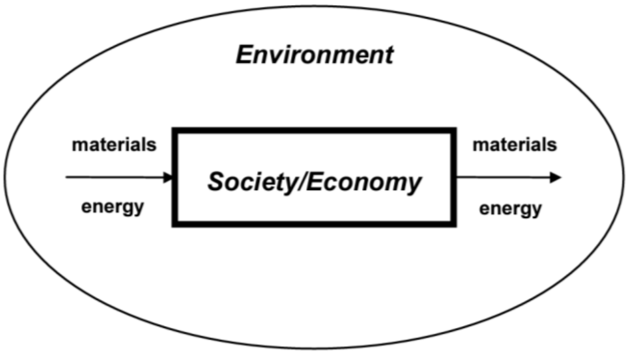

Figure 15.1The economy/environment system (European Communities, 2001)

The SEM concept, the basis on which MFA is built upon, dates back to Karl Marx's works, and evolved through time (Fischer-Kowalski, 1998). MFA has been prominently developed and implemented starting from the early 90s, its indicators have been advanced and standardized, and the method has been adopted by several organizations (Krausmann et al., 2017). The MFA method accounts consists of inventories of material inputs in the socio-economic system, changes in stocks within the socio-economic system, and material outputs to the environment and/or other socio-economic systems. It calculates several different indicators, used to assess the pressure on the environment. Some of the calculated indicator are: the Domestic extraction (DE), measuring the materials used extracted domestically; the Total Material Requirement (TMR), measuring all the materials, used and unused, required for domestic production and consumption; the Domestic Processed Output (DPO), indicating the materials released to the domestic environment in the form of waste, emissions, or purposeful outputs; the Material Footprint (MF), accounting for the global material use for domestic consumption; the Materials Stock (MF), calculating the materials accumulated in in-use stocks; the Material Productivity (MP), representing the value added produced per unit of domestic consumption. In recent times, the focus of the discussion has changed to emphasize the importance of considering a production-oriented viewpoint as opposed to a consumption-oriented one. It has become increasingly clear that the consequences of leakage effects and the shifting of burdens, which are connected to the expansion of trade, are exerting a growing influence on the patterns of resource flows (Kovanda & Weinzettel, 2013), by inducing a relocation of industries from developed to developing countries due to rigid policies and increasing prices in developed countries (Safarzynska et al., 2023).

15.3 Life Cycle Thinking

The Life Cycle Thinking (LCT) approach aim at focusing on the entire chain of stages delivering products and/or services, acknowledging that each stage has to potential to reduce environmental, social and economic impacts. It borrows the concept of 'life cycle' from biology, distinguishing every step of the cycle from the others. The LCT framework includes different approaches for the three sustainability dimension, namely the LCA, the LCC and the s-LCA.

15.3.1 Life Cycle Assessment

The LCA method aims at assessing the environmental impacts of transformation processes under human control with a cradle-to-grave approach, starting from the extractions of raw materials to final disposal of waste. The LCA is a worldwide established method for environmental assessment, highly standardized and defined (ILCD, 2010; ISO, 2006a, 2006b). The first life cycle-oriented assessments were performed back in the 1960s, with great developments throughout the 90s and the first years of 2000 (with the development of widely used softwares and databases).

According to the ISOs norms/standard, LCA analyses are performed through a 4-step iterative process (**Figure 15.2**):

Goal & Scope definition: the goal of the study, among other things, is stated. The functional unit (FU) and the boundaries of the case study are defined. The FU is a measure of the function(s) of the studied system. It provides a reference to which the inputs and outputs can be related. The boundaries (physical, geographical and temporal) define which parts of the life cycle and which processes belong to the analysed system. They separate the analysed system from the rest of the technosphere and from the ecosphere.

Life Cycle Inventory (LCI): the LCA study is performed by compiling a careful inventory of the input flows (materials, energy) and of the output flows (products, by-products, waste, emissions) of the investigated system. Data can be directly collected (primary data), retrieved from literature and/or databases (secondary data), coming from calculations and assumptions (tertiary data).

Life Cycle Impact Assessment (LCIA): the obtained inventories are converted into environmental impacts. This is usually performed by means of software applications (i.e., SimaPro, Gabi, OpenLCA), databases (i.e., Ecoinvent database) and impact methods (i.e., ReCiPe Impact Method), the latter providing suitable conversion factors to calculate characterized and normalized indicators. LCA results express the impacts in several environmental compartments as different indices of emissions (carbon equivalent emissions, toxicity emissions, eutrophication emissions, among others) and of resource use (fossil depletion, metal depletion, land use, water use).

Interpretation: the data, result and insights calculated are used to understand the investigated case study. The results are discussed and compared to suitable benchmarks and the hot-spots of the study are highlighted, in order to propose feasible recommendations and improvements.

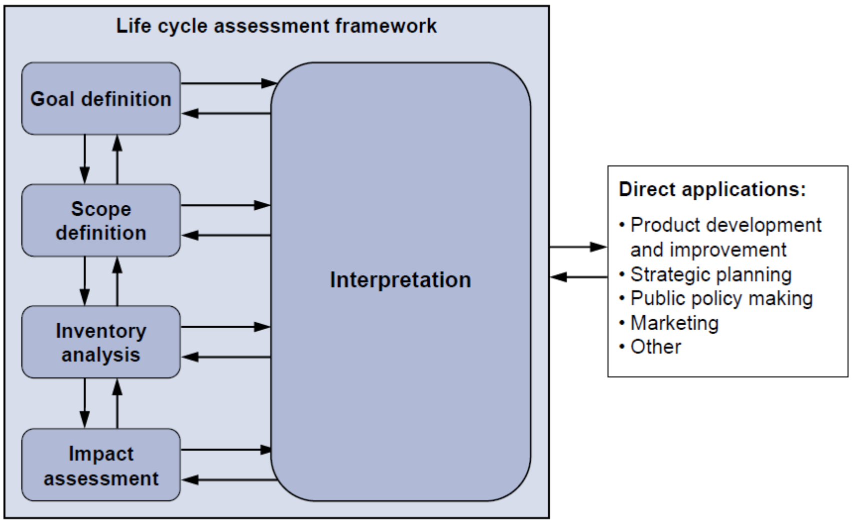

Figure 15.2 The LCA framework (ILCD, 2010)

The LCA method is capable of delivering the environmental impacts within several categories, related to several environmental compartments, and of connecting the fraction of impacts to the stage producing it. However, it is not useful when trying to assess anything outside the anthropic technosphere (e.g., transformations happening outside the human controlled industrial environment). In addition, even though very standardized, the opportunity for the practitioners to take decisions in very important points of the analysis (e.g., choice of FU and boundaries) might hinder the comparability.

15.3.2 Life Cycle Costing

The Life Cycle Costing (LCC) method is defined as 'the sum of all funds expended in support of the item from its conception and fabrication through its operation to the end of its useful life' (White & Ostwald, 1976). Thus, it represents an assessment of the costs over the life cycle of a product or system (**Figure 15.3**). As the other Life Cycle oriented tools, LCC could be used to plan, to optimize, to identify hotspots. It aims at choosing the most cost-effective strategies in order to achieve the least long-term cost of ownerships (Ghagare et al., 2017).
It accounts for two types of costs:

- Internal costs: costs, borne by a stakeholder, happening along the life cycle of products/services related to production, use and end of life;
- External costs: externalities (e.g., environmental and/or social costs) not met by any stakeholder, that should be relevant in decision making.

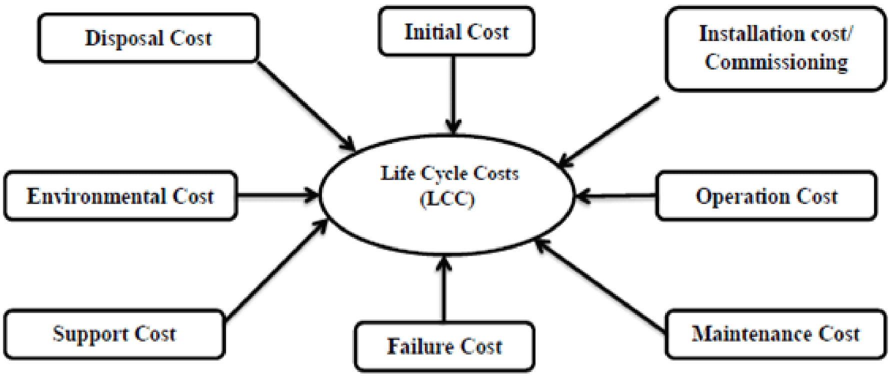

Figure 15.3 LCC major components (Ghagare et al., 2017)

Three variants of LCC have been proposed, to acknowledge the different goals, needs and points of view of different stakeholders: the conventional or financial LCC (cLCC), the environmental LCC (eLCC) and the societal LCC (sLCC) (Hunkeler et al., 2008).

cLCC is a profit-oriented framework used mainly as a decision-making tool, only considering internal costs, and performed in a single actor perspective. It allows manufacturers to subdivide the costs according to production stages and end-of-life activities.

eLCC is more consistent with LCA and ISO standards in terms of FU, boundaries, and including all life cycle stakeholders, meaning that also external costs are included. Thus, eLCC is developed and used to support LCA by adding the economic dimension to the environmental one.

sLCC aims at supporting public authorities and governments in decision making by including selected externalities and assigning them a monetary value. These externalities are from both the environmental and social perspectives, thus including, among others, the cost of repairing environmental and social damage, job quality, wellbeing. In so doing, the sLCC tries to incorporate the costs of the three pillars of sustainability (economic, environmental and social) in a single monetary unit. However, economic costs show a wide spatial and temporal variability, which causes a significant amount of uncertainty in the analysis.

15.3.3 Social Life Cycle Assessment

Social Life Cycle Assessment (S-LCA) represents an innovative approach for the understanding of the social burdens linked to the entire life cycle of products and services. Nevertheless, its precise definition remains a work in progress. The most spread definition follows the international voluntary guidelines established through collaboration between UNEP (United Nations Environment Programme) and SETAC (Society of Environmental Toxicology and Chemistry). This definition characterizes S-LCA as an evaluation method (**Figure 15.4**) with the aim of appraising the social and socio-economic dimensions of products, including their potential positive and negative impacts, opportunities and risks, across their entire life cycle, spanning from the extraction and processing of raw materials, through manufacturing, distribution, use, re-use, maintenance, recycling, to final disposal (Andrews et al., 2009). In this context, social impacts are defined as the outcomes of positive or negative pressures on social endpoints, primarily pertaining to the well-being of stakeholders (STAR-ProBio, 2019). These outcomes arise from social interactions woven into the fabric of activities such as production, consumption, or disposal, and are influenced by various stakeholders' preventive or reinforcing actions.

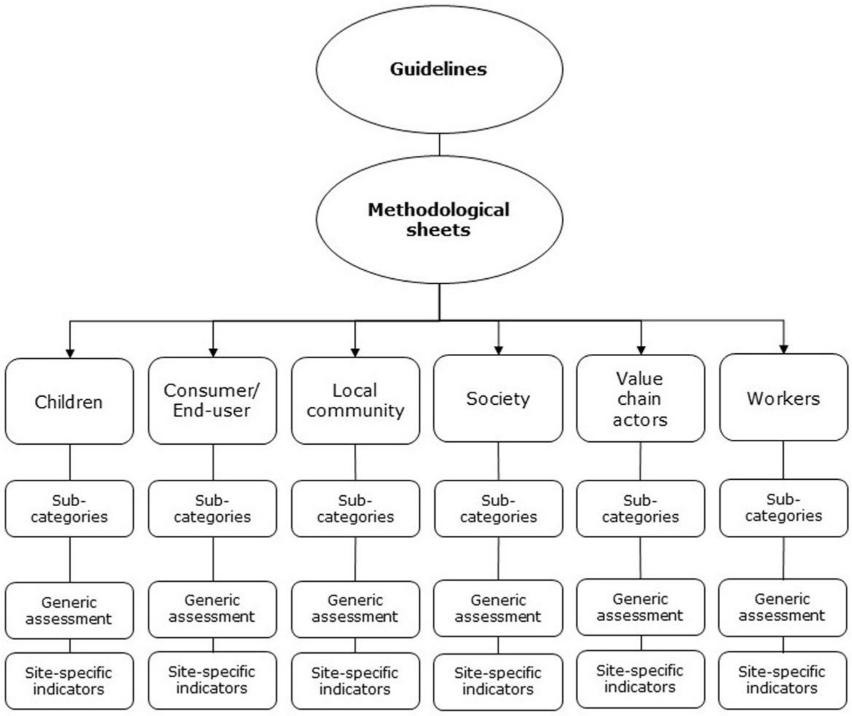

Figure 15.4 s-LCA framework (Lundgren, 2023)

Numerous researchers have put forth different frameworks for S-LCA, all of which demanding comprehensive data. Furthermore, social indicators can be highly subjective and subject to varying interpretations within the literature. This subjectivity could introduce biases, particularly when assigning weighting factors to determine the relative significance of each impact category (STAR-ProBio, 2019), and also prevents the comparability of social indicators across different studies. It was only in 2013 that UNEP and SETAC initiated specific guidelines to standardize knowledge and unify the evaluation methods. Thus, transparency is of utmost importance when conducting s-LCA. The methodology for S-LCA follows the same stages as for Life Cycle Assessment (LCA), as outlined in the ISO framework (ISO, 2006a, 2006b).

S-LCA takes into account aspects such as workplace hierarchies, production management and planning, unemployment, skills and knowledge, societal infrastructure demands, culture, child labor, poverty, and fair-trade practices. To conduct a social assessment, the identification of all the stakeholders involved is crucial, including workers, consumers, the local community, broader society, and value chain participants. The S-LCA impact categories encompass human rights, working conditions, health and safety, cultural heritage, governance, and socio-economic consequences. Impact subcategories are related to the specific analytical topics within these six impact categories for each group of stakeholders. Stakeholders' category can include, among others, prosumers (producers/consumers), local community, workers, society (Kaiser et al., 2022). Organizing an inventory within subcategories is necessary to comprehensively assess the social, sociological, and socio-economic impacts of products throughout their life cycle. This evaluation calls for a diverse range of expertise, spanning sociology, anthropology, sociology, and management sciences (UNEP, 2021; van Haaster et al., 2017; Zamagni et al., 2015).In a just transition perspective, the S-LCA method provides an easy way to collect information about the social implications related to products and services. However, several critical points emerge about participation in shaping the impact categories and the rationale of the method itself.

15.4 Emergy Accounting

The Emergy Accounting (EMA) method is a thermodynamic based type of analysis that assesses the ecosystem support to transformation processes. It accounts for differences in quality of the different kinds of resources, materials and energy, based on the work from the biosphere for their generation (Odum, 1996). EMA applies an upstream perspective in accounting for direct and indirect contributions to systems, resource generation, ecosystem services and societal aspects (Santagata et al., 2020). It is defined as the 'the available energy of one kind, usually solar, directly or indirectly used in a system for transformations leading to a product or a service' (Brown & Ulgiati, 2004a; Odum, 1996). The unit of emergy is the solar emjoule (sej). The total emergy (U) is the entire environmental support to transformation processes. It is calculated by multiplying an inventory of input flows by appropriate conversion factors, called Unit Emergy Values (UEVs). These factors, measured as sej/unit-of-input, express the environmental support to generate 1 unit of input flow. UEVs are calculated by dividing the total emergy U of a process by the yield of product/service delivered. When UEVs are expressed as sej/J, they are referred to as 'transformities' (Odum, 1996). By default, the transformity of solar energy is equal to 1 sej/J. UEVs are calculated with reference to a Global Emergy Baseline (GEB), expressing the total emergy driving the biosphere. The most recent and accepted GEB is equal to 12.0E+24 sej/year (Brown & Ulgiati, 2016). The resources used in transformation can be classified as locally available renewable (R), locally available non-renewable (N) and imported non-renewable (F), the latter also including the support from direct and indirect human labour (L&S, Labour and Services) (**Figure 15.5**).

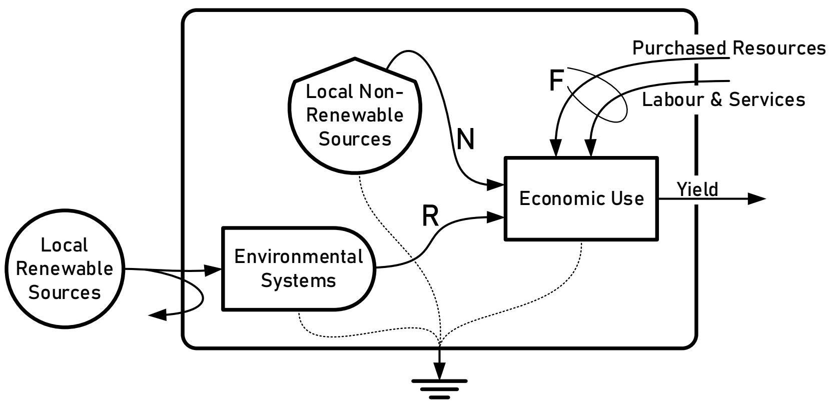

Figure 15.5 EMA framework

This classification allows the calculation of several based indicators (Brown & Ulgiati, 2004b), as, among others:

- Emergy Yield Ratio: EYR = U/F, measuring the performance in providing a yield by investing outside resources.
- Environmental Loading Ratio: ELR = (N+F)/R, quantifying the load of a system on the environment.

- Environmental Sustainability Index: ESI = EYR/ELR, assessing the ability of using the least share of imported resources with the minimum load.
- Renewable fraction of emergy used: %REN = R/U. It indicates the fraction of emergy from local renewable resources.

EMA indicators provide insights about the process sustainability at the biosphere scale (Santagata et al., 2020). The EMA method is very powerful when considered as an alternative theory of value, as value is assigned not from an economic point of view but based on the biosphere 'work' in delivering things. It also includes important information from a just transition point of view, as the accounting of direct and indirect human labour and of the local/imported resources. However, the EMA method suffers from a lack of a shared UEVs database and from a still not standardized accounting procedure.

15.5 Net Present Value and Internal Rate of Return

The Net Present Value (NPV) method is used to assess and to rank the feasibility of projects and investments. It takes into account the time value of money, referring to the difference between the present value of all cash inflows and the present value of all cash outflows. As a general rule, a project is accepted when NPV>0 and rejected when NPV<0 (Bora, 2015).

The NPV is calculated as in Eq.1, where I represent the initial cost, b_t is the future net benefits, r is the discount rate and T is the length of the period of time:

$$Eq.1): \qquad \mathrm{NPV} = -\mathrm{I} + \sum_{t=1}^{T} b_t \left(\frac{1}{1+r}\right)^t$$

The NPV is often used to model the economic feasibility of environmental interventions. However, it represents an aggregated indicator, not always suitable for the inclusion of different, frequently contrasting, aspects (Knoke et al., 2020).

The Internal Rate of Return (IRR) is a financial metrics representing the return that can be earned on the capital invested in the project (Withers et al., 2009). Is therefore used to estimate the profitability (or the potential profitability) of projects (Mellichamp, 2017). At first, the IRR was meant to calculate the annual return on a purchase paid in cash and sold a certain number of years later. Basically, it represents the percentage rate earned on each economic unit invested for each period it is invested (Schmidt, 2013). The IRR formula solves for the interest rate that sets the net present value (NPV) equal to zero (Eq.2), where N is the total number of periods, n is a single period between 0 and N, and CF is the cash flow in period n.

$$Eq.2): \qquad 0 = \sum_{n=0}^{N} \frac{CF_n}{(1+IRR)^n}$$

Thus, the IRR metric incorporates the return performance of different sub-periods in a single value, without giving information on the patterns of the considered cash flows (Newell, 1986). The IRR value is used to support the decision of accepting a project if the IRR is higher than the cost of capital. It is also used to rank projects: the higher the IRR, the higher the rank (Magni, 2010).

Both the NPV and IRR methods might be used as a first analysis of the economic profitability of circular economy strategies, but their strict mono-dimensional perspective fails in acknowledging the important social and environmental aspects necessary for a just transition.

15.6 Gender Equality Assessment

Women's empowerment, inclusion and engagement is a long-recognized topic, acknowledged, among others, in global conferences (United Nations, 1995) and by the UN Sustainable Development Goals (United Nations, 2018), in particular SDG 5: 'achieve gender equality and empower all women and girls'. The 1995 Beijing Conference is particularly significant for the shift from the discourse of Women in Development (WID), a mainly economic perspective, to Gender And Development (GAD), with a widened approach including welfare, equity, anti-poverty and empowerment (MacArthur et al., 2021). Studies about gender equality show qualitative and quantitative approaches, or a mix of the two. Among others, one of the most prominent tools is the Gender Equality Capacity Assessment Tool proposed by the UN Women Training Centre (UN Women, 2014). The tool is used to assess the aptitude of organizations and individuals towards gender equality and empowerment of women. The analysis is performed by means of questionnaires, surveys, interviews and test, in order to evaluate policies, strategies and procedures. However, the implementation of these directly collected primary data might be time and resource demanding, and not always easy to be carried out. The results are then compiled into reports for dissemination. The surveys usually include general information, educational background, previous experience and knowledge about gender equality and women's empowerment, and personal opinions about the learning styles and needs to improve the awareness about the topic. A similar questionnaire-based approach is adopted by the Gender Equality Assessment Tool developed by Save the Children, used to support the organization sponsorship programming. It consists of four questionnaires and an Action Plan Template. The questionnaires include sub-categories relevant for the sponsorship programs, with a self-rating of 0 to 3 and the possibility to provide justification for the self-assigned rating. The Action Plan is then used to understand, among other things, timeframe, next steps and key staff (Save the Children, 2020). Large-scale quantitative research about gender-related issues is quite rare, mainly because of the limited data to support statistical type of analyses of the complex and intersecting patterns of inequalities related to gender, class, ethnicity, and age. Still, quantitative and statistic indicators could be useful in tracing the change of rate and patterns of these issues in different levels of society (Scott, 2010). For a comprehensive discussion about gender, justice, and Circular Economy, see Martínez Álvarez & Barca (2023) and chapter 18 of this volume.

15.7 Conclusions

The transition to the CE paradigm will involve all aspects of human societies. Thus, suitable methods for tracing and assessing the expected change will be needed, capable of acknowledging all the different sectors, i.e., economic, social, and environmental, and their intercorrelations and networking patterns. Each method answers a single, particular question. Taking into consideration the capabilities, the specificity and also the limitations of all or some of the involved methods (i.e., lack of standardization, high reductionist approaches, mono-criteria perspectives, etc.) is a powerful strategy to become able to reach a widespread point of view for a holistic understanding of the issues to be overcome. The quantitative/qualitative assessment of a just transition to Circular

Economy would need the implementation, and the integration, of different metrics to include and consider the environmental, social and economic dimensions of a fair transition. Although the scientific literature presents different attempts for a multidisciplinary approach to the Circular Economy, more efforts from a regulatory point of view are needed to make these efforts significative.

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Chapter 16. Using input-output stock-flow consistent models to simulate and assess 'circular economy' strategies

M. Bimpizas-Pinis, A. Genovese, A. Kaltenbrunner, E. Kesidou, B. Purvis, J.B. Ramos Torres Fevereiro, O. Valles Codina, and M. Veronese Passarella

Abstract: The CE paradigm has gained significant traction in both academic and industrial circles over the past decade. While there is an intuitive association between transitioning to a CE and achieving a more sustainable society, there has been limited scrutiny regarding its economic viability. To address this, macroeconomic tools are needed to assess the impacts of CE policies on society, the economy, and the ecosystem. The field of ecological macroeconomics can meet this need through various promising modelling approaches. This chapter has two main objectives. Firstly, it provides a brief overview of macroeconomic modelling developments that address CE issues, with a focus on the most widely used approaches and tools. Secondly, the chapter argues that combining input-output (IO) analysis with stock-flow consistent (SFC) modelling is one of the most promising methods for simulating, assessing, and comparing CE strategies. To support this argument, the main features of a simplified IO-SFC model for a capitalist economy are presented and discussed. In this model, money is endogenously created, production is demand-driven, and the macro-economy is divided into industries that produce goods and services while generating waste and CO2 emissions. The results demonstrate that restructuring production and consumption patterns to adopt CE-driven practices is insufficient to ensure a transition to a more sustainable economy, as long as production decisions remain driven by private interests.

Keywords: Circular Economy, Stock-Flow Consistent Models, Input-Output Analysis, Waste, Carbon Emissions

> This contribution emphasises the need for macroeconomic tools to assess the impacts of CE policies on society, the economy, and the ecosystem. It highlights the potential of combining input-output analysis with stock-flow consistent modelling for effective simulation and comparison of CE strategies.

16.1 Introduction

The concept of CE has gained significant traction in both academic and industrial spheres over the past decade. While transitioning towards a CE is intuitively associated with a more sustainable society, there has been limited examination of its economic viability. To address this gap, there is a need for macroeconomic tools that can assess the impacts of CE policies on society, the economy, and the ecosystem. The field of ecological macroeconomics can fulfil this requirement through various promising modelling approaches.

This chapter aims to achieve two objectives. Firstly, it provides a brief overview of the literature on macroeconomic modelling advancements in addressing CE issues, with a focus on the most widely used approaches and tools. Secondly, the chapter argues that combining IO analysis with stock-flow consistent SFC modelling represents one of the most promising methods to simulate, evaluate, and compare CE strategies. To support this argument, the main features of a simplified IO-SFC model for a multi-area capitalist economy under different exchange-rate regimes are presented and discussed. In this model, money is endogenously created, production is driven by demand, and the macro-economy is divided into one or two regions and industries that produce goods and services while generating waste and CO2 emissions.

Before a systematic in-depth investigation of many CE scenarios, our preliminary results indicate that restructuring production and consumption patterns to adopt CE-driven practices alone is insufficient to ensure the transition towards a more sustainable economy, as long as production decisions remain driven solely by private interests. For instance, critical industries for the CE transition may employ more men than women, potentially reinforcing rather than weakening the gender income gap. Similarly, CE interventions limited to the GN might result in economic losses, unemployment, or over-extraction of natural resources in the GS, especially if the core-periphery structure of the international division of labour is neglected. In summary, a greater involvement of the government sector is indispensable in planning a just transition to a circular economy, as it cannot be solely left to market forces.

16.2 IO models for CE analysis: the state of the art

Although the CE has garnered significant attention in scientific literature, a comprehensive systematic review of key contributions on CE practices and strategies, along with their macro-level or societal impact, has not yet been published. Notably, Bimpizas-Pinis et al. (2022) stands out as an important exception, as the authors conducted a systematic analysis utilizing the SCOPUS database. They identified nearly 50 thousand unique articles based on 22 relevant keywords. To focus the literature, they selected papers that explicitly addressed macroeconomic *modelling* and/or provided an ex-post evaluation or ex-ante scenario analysis of CE interventions, along with an assessment of the impact on socio-economic variables such as GDP, employment, prices, costs, profits, and wages.

After this refinement process, a final dataset of 55 relevant studies was compiled. These studies can be categorized into three main groups: (a) IO analysis with exogenous determination of final demand (38 studies), (b) IO models with econometric estimation of the evolution of final demand (4 studies), and (c) Neoclassical models, including CGE models, dynamic stochastic general equilibrium (DSGE) models, and some Integrated Assessment Models (IAMs) (13 studies) (Bimpizas-Pinis et al., 2022).

It is worth noting that this review provides a comprehensive overview of the current literature on macroeconomic *modelling* and its relationship to CE interventions and impacts, making it an important reference for further research in the field.

16.2.1 Type I input-output models

Interestingly, the majority of IO-based CE publications assume an exogenous determination of final demand, which can be referred to as type I input-output models. IO analysis, pioneered by Leontief (1936, 1941) and discussed by Miller and Blair (2009), is an analytical tool that represents interdependencies among sectors or industries within a national or regional economy. IO tables are compiled by national statistical offices and depict transaction flows in an inter-industry table. An IO table shows the destination of sector-related outputs, which can serve as inputs for other sectors in production or be purchased as final products or services by households, firms, the government, or the foreign sector through consumption, investment, government spending, and exports.

The benchmark Leontief IO model determines the quantity of total output needed to meet each level of final demand based on relative prices and available technology. It enables the calculation of the impacts of fluctuations in final demand and technological changes on total output. The benchmark IO model relies on several fundamental assumptions: (i) constant returns to scale, meaning technical coefficients do not depend on production scale; (ii) fixed proportions of factors of production without substitution possibilities; (iii) use of a single technology per sector and production of a single homogeneous product; (iv) no impact of price changes on final demand (zero price-elasticity of demand); (v) absence of supply constraints on labour, capital, natural resources, and financial constraints.

However, it is possible to combine IO analysis with other modelling frameworks that endogenize final demand explicitly, such as: IO models with econometrically estimated evolution of final demand (type b) and IO models based on neoclassical principles like CGE models (type c). When IO tables are integrated with environmental accounts, such as waste flows, emissions, or material use, EEIO models and WIO tables can be derived. These models allow for the analysis of the impacts of changes in technology and final demand on the broader ecosystem. EEIO analysis combines conventional IO tables (expressed in monetary units) with environmental variables (emissions, waste, extraction, resource depletion) for each sector. These additional variables are typically measured in physical units and included in satellite accounts. WIO explicitly introduces waste treatment sectors (e.g., incineration, landfilling, recycling) in the columns of an IO table. These sectors demand waste generated by productive sectors and final demand as inputs and produce treated waste or recycled materials used as intermediate inputs by productive sectors. Therefore, the IO table is expanded in the rows. It is important to note that the total waste generation per sector is net of recycled waste. Increased recycling reduces the waste generation coefficient in each sector. Recycled materials, demanded as inputs by productive sectors, are represented by positive coefficients in the recycling sector.

This methodology can be applied to various CE interventions, including but not limited to alternative end-of-life strategies for electrical appliances, recycling, landfilling, and simple shredding (Kondo and Nakamura, 2004; Nakamura and Kondo, 2006).

16.2.2 Type II input-output models

In type II or macro-econometric input-output (MEIO) models, the level and composition of final demand are not exogenous but determined through econometric equations, with coefficients estimated from observed data. Once the final demands are determined for each sector, total outputs are defined using a standard Leontief IO table, which operates on a quantity basis. MEIO models are categorized as demand-driven models, in contrast to neoclassical CGE, DSGE, and standard IAM approaches, which are supply-side models. MEIO models also econometrically determine labour market variables such as hours worked, employment rate, participation rate, etc. These variables are defined as functions of estimated real output, real wage costs, and other factors. Unlike most CGE models, MEIO models do not assume neoclassical conditions. The economy does not converge to a pre-defined equilibrium level of output, let alone full employment. Perfect rationality and perfect competition are also

rejected. Economic agents in MEIO models are assumed to operate in imperfect markets under bounded rationality conditions.
Examples of MEIO models that address environmental issues include E3ME (Cambridge Econometrics 2014), PANTA-RHEI (Meyer et al., 2007, 2012), and GINFORS (Giljum et al., 2008; Distelkamp and Meyers, 2019). Overall, MEIO models tend to be optimistic about the possibility of achieving green economic growth, even when considering rebound effects. It should be noted that the demand-driven nature of these models implies that investment in new technologies associated with CE practices will generally stimulate economic growth, at least during the transition phase. Furthermore, the investigated CE practices in the reviewed papers typically involve high resource efficiency. On closer examination, what is being modelled is an increase in productivity that, coupled with the assumption of fixed mark-ups, influences prices. This, in turn, stimulates final demand both directly (through the price effect) and indirectly (through the income effect). Similarly, increases in recycling are linked to higher expenditures and employment requirements compared to other forms of resource waste management, resulting in higher income and employment multipliers. However, other CE strategies, such as product life extension or functional economy practices, are likely to be less effective in terms of output and employment generation.

16.3 SFC models for CE analysis: bridging the gap

SFC models can be considered a specific class of system dynamics tools, primarily developed by post-Keynesian macroeconomists since the early 2000s (Godley and Lavoie, 2006; Caverzasi and Godin, 2015; Nikiforos and Zezza, 2017). In the last decade, SFC models have gained traction in ecological macroeconomics due to their ability to integrate consistently and comprehensively the flows and stocks of the economy and the ecosystem (Carnevali et al., 2019). This feature makes them highly flexible and versatile for simulating, analyzing, and comparing alternative environmental policy scenarios. However, one limitation is that SFC models only consider aggregate output, neglecting the interdependencies between different industries.
Formally, SFC models are dynamical systems of discrete-time difference equations (or occasionally continuous-time differential equations), where accounting identities are coupled with equilibrium conditions and behavioral equations. These behavioral equations are typically based on post-Keynesian principles, including the following: a) economic agents have target stock-flow norms they aim to achieve; b) money is endogenously created by the banking sector; c) supply tends to adjust to demand in the short and long run, rather than the other way around.
In theory, SFC behavioral equations can be based on any theoretical framework. Notably, despite their focus on cost optimality, most CGE models are also stock-flow consistent, although they lack the dynamic aspect. Additionally, unlike SFC models, CGE models usually concentrate on the real economy and exclude the financial sector. While SFC models are often aggregative, they can also be microfounded by deriving the emerging behavior of aggregate variables from the interaction of heterogeneous agents (AB-SFC) (Caiani et al., 2016) or mesofounded by explicitly considering the IO structure of the production sector (IO-SFC) (Berg et al., 2015).
SFC analysis is particularly well-suited to capture the dynamic interactions between the economy and the environment (Dafermos et al., 2017, 2018), as similar theoretical models are already widespread in the natural sciences in the form of system dynamics models. SFC models offer a promising alternative to standard neoclassical tools (such as CGE models) for analyzing the institutional interaction between the economy and the ecosystem. However, there have been few applications of such models to test and compare CE practices, with

exceptions being Veronese Passarella (2022) and Genovese et al. (2023). One reason for this is that standard SFC models only consider aggregate output and overlook the vertical interdependencies between different industries. Nevertheless, some hybrid IO-SFC models have been developed in recent years (Berg et al., 2015; Valdecantos and Valentini, 2017) that can be used to model the transition towards a CE system. The remainder of this chapter is based on the prototype IO-SFC model developed by Veronese Passarella (2022) and Genovese et al. (2023), which is used to test a simple CE experiment in a single-country economy and a two-country or two-area economy, respectively.

16.4 Main features of the model

Although IO-SFC models are still uncommon in macroeconomics and ecological economics, progress has been made in recent years. Veronese Passarella (2022) and Genovese et al. (2023) have transformed a standard aggregative SFC model (based on Godley and Lavoie, 2007) into meso-founded models that incorporate the endogenous creation of both fiat money and bank money. These models also feature market prices adjusting to Sraffa-like reproduction prices, and they disaggregate the economy both vertically (social sectors) and horizontally (production industries). Both models share the same theoretical assumptions and analytical structure. The main difference is that Veronese Passarella (2022) focuses on the impact of CE innovations on the domestic economy, while Genovese et al. (2023) extend the analysis to a two-area economy, explicitly considering the effects of cross-border trade and portfolio investment. In this section, we discuss the key findings associated with a CE innovation in a single-country model and then examine its implications for a multi-country economy.
Each national economy considered consists of five domestic macroeconomic sectors: a) households (which are further divided into wage earners and rentiers); b) private production firms; c) the government sector; d) commercial banks; and e) the central bank. The single-country model also includes a stylized foreign sector, which tracks trade and financial flows with the rest of the world. In the two-area model, each country shares the same institutional structure, and there are no barriers to trade or restrictions on capital flows. Households receive both labour incomes (wages) and capital incomes (profits and interest payments) and purchase consumption goods based on their disposable income and net wealth. Household savings consist of cash (currency), bank deposits, and government bills. The baseline scenario involves three industries (manufacturing, agriculture, and services) where firms produce three outputs (and waste) using the same products as inputs. For simplicity, real supplies always adjust to real demands, and firms do not hold inventories. However, firms accumulate fixed capital and finance their production plans through bank loans. As mentioned, corporate incomes are entirely distributed to households. Bank deposits are created as long as banks grant loans to firms and/or upon demand, while cash is issued by the central bank when the government sector runs budget deficits and/or commercial banks obtain advances.
Both models are coded and simulated in an R environment. Model parameters and exogenous variables have been selected to approximate the baseline scenario discussed by Vallès Codina and Fevereiro (2022). Initial values for endogenous variables are set to zero, and simultaneous solutions for endogenous variables have been obtained through 100 iterations per period. The economy is set in motion by an initial expenditure from the government sector. Private firms produce goods and services based on demand, leading to an increase in output, disposable income, consumption, investment, and imports (and exports). The economy experiences growth following the initial shock and eventually stabilizes at a new steady state, where private consumption equals disposable income

and the stock of net wealth remains unchanged (ensuring that households achieve their target wealth-to-income ratio). Economic activity results in the production of waste and CO2 emissions. The models also consider its impact on the functional distribution of income and gender segregation in the labour market, accounting for variations in the share of female workers across industries (assuming that the female labour force is uniformly distributed across industries in both the baseline scenario and the experiments discussed here).

Tables 16.1 and **16.2** depict the balance sheets of the single-country model and the two-area model, respectively. **Tables 16.3** and **16.4** present the corresponding transaction-flow matrices. **Figure 16.1** and **Figure 16.2** illustrate cross-sector (and cross-area) payments and their effects on financial stocks, confirming the integrity of the models (where every payment originates from somewhere and goes to somewhere, and any changes in financial assets/liabilities of one sector are matched by opposite changes in financial assets/liabilities of other sectors). Lastly, **Tables 16.5** and **Table 16.6** and **Figure 16.3** display the input-output matrix of each domestic economy and the flows of inputs across industries in the single-country model.

Table 16.1. Balance sheet in period t = 20, single-country model, baseline scenario

	Households	Firms	Government	Banks	Central Bank	Foreign sector	Total
Money	46.50	0.00	0.00	0.00	-46.5	0.00	0.00
Advances	0.00	0.00	0.00	0.00	0.0	0.00	0.00
Deposits	272.70	0.00	0.00	-272.70	0.0	0.00	0.00
Loans	0.00	-36.64	0.00	36.64	0.0	0.00	0.00
Bills	35.47	0.00	-367.63	236.06	46.5	49.61	0.00
Capital stock	0.00	36.64	0.00	0.00	0.0	0.00	36.64
Net financial wealth	-354.66	0.00	367.63	0.00	0.0	-49.61	-36.64
Total	0.00	0.00	0.00	0.00	0.0	0.00	0.00

Table 16.2 Balance sheet in period t = 20, two-area model, baseline scenario

	H1	F1	G1	B1	CB1	xr1	H2	F2	G2	B2	CB2	Tot
Money	78.46	0.00	0.00	0.00	-78.46	1	78.27	0.00	0.00	0.00	-78.27	0.00
Advances	0.00	0.00	0.00	0.00	0.00	1	0.00	0.00	0.00	0.00	0.00	0.00
Deposits	492.73	0.00	0.00	-492.73	0.00	1	479.60	0.00	0.00	-479.60	0.00	0.00
Loans	0.00	-121.88	0.00	121.88	0.00	1	0.00	-122.57	0.00	122.57	0.00	0.00
Area 1 Bills	22.46	0.00	-481.55	370.84	73.38	1	14.86	0.00	0.00	0.00	0.00	0.00
Area 2 Bills	15.22	0.00	0.00	0.00	5.07	1	21.82	0.00	-477.42	357.02	78.27	0.00
Capital stock	0.00	121.88	0.00	0.00	0.00	1	0.00	122.57	0.00	0.00	0.00	244.46
Net financial wealth	-608.87	0.00	481.55	0.00	0.00	1	-594.56	0.00	477.42	0.00	0.00	-244.46
Total	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

Table 16.3 Transactions-flow matrix in period t = 20, single-country model, baseline scenario

	Households	Firms (current)	Firms (capital)	Government	Banks	CB	Foreign	Total
Consumption	-523.70	523.7	0.00	0.00	0.00	0.00	0.00	0
Investment	0.00	11.07	-11.07	0.00	0.00	0.00	0.00	0
Government spending	0.00	180.17	0.00	-180.17	0.00	0.00	0.00	0
Export	0.00	73.34	0.00	0.00	0.00	0.00	-73.34	0
Import	0.00	-78.83	0.00	0.00	0.00	0.00	78.83	0
[Value added]	0.00	[709.45]	0.00	0.00	0.00	0.00	0.00	0
Wage bill	322.17	-322.17	0.00	0.00	0.00	0.00	0.00	0
Corporate profit	384.85	-384.85	0.00	0.00	0.00	0.00	0.00	0
Amortization	0.00	-1.35	1.35	0.00	0.00	0.00	0.00	0
Bank profit	4.68	0	0.00	0.00	-4.68	0.00	0.00	0
Tax revenue	-143.07	0	0.00	143.07	0.00	0.00	0.00	0
Interests on deposits	4.68	0	0.00	0.00	-4.68	0.00	0.00	0
Interests on loans	0.00	-1.08	0.00	0.00	1.08	0.00	0.00	0
Interests on bills	1.22	0	0.00	-11.19	8.28	0.00	1.70	0
Change in money stock	-6.94	0	0.00	0.00	0.00	6.94	0.00	0
Change in advances	0.00	0	0.00	0.00	0.00	0.00	0.00	0
Change in deposits	-38.80	0	0.00	0.00	38.80	0.00	0.00	0
Change in loans	0.00	0	9.72	0.00	-9.72	0.00	0.00	0
Change in bills	-5.08	0	0.00	48.29	-29.08	-6.94	-7.19	0
Total	0.00	0	0.00	0.00	0.00	0.00	0.00	0

Table 16.4 Transactions-flow matrix in period t = 20, two-area model, baseline scenario

	H1	F1(curr)	F1(kap)	G1	B1	CB1	xr1	H2	F2(curr)	F2(kap)	G2	B2	CB2	Tot
Consumption	-784.70	784.7	0.00	0.00	0.00	0.00	1	-779.48	779.48	0.00	0.00	0.00	0.00	0
Investment	0.00	6.09	-6.09	0.00	0.00	0.00	1	0.00	6.13	-6.13	0.00	0.00	0.00	0
Government spending	0.00	180.2	0.00	-180.20	0.00	0.00	1	0.00	180.2	0.00	-180.20	0.00	0.00	0
Export of Area 1	0.00	32.17	0.00	0.00	0.00	0.00	1	0.00	-32.17	0.00	0.00	0.00	0.00	0
Import of Area 1	0.00	-30.07	0.00	0.00	0.00	0.00	1	0.00	30.07	0.00	0.00	0.00	0.00	0
[Value added]	0.00	[973.09]	0.00	0.00	0.00	0.00	1	0.00	[963.72]	0.00	0.00	0.00	0.00	0
Wage bill	576.11	-576.11	0.00	0.00	0.00	0.00	1	472.15	-472.15	0.00	0.00	0.00	0.00	0
Corporate profit	386.01	-386.01	0.00	0.00	0.00	0.00	1	480.54	-480.54	0.00	0.00	0.00	0.00	0
Amortization	0.00	-6.09	6.09	0.00	0.00	0.00	1	0.00	-6.13	6.13	0.00	0.00	0.00	0
Bank profit	9.82	0	0.00	0.00	-9.82	0.00	1	9.61	0	0.00	0.00	-9.61	0.00	0
CB profit	0.00	0	0.00	3.14	0.00	-3.14	1	0.00	0	0.00	3.13	0.00	-3.13	0
Tax revenue	-196.88	0	0.00	196.88	0.00	0.00	1	-194.96	0	0.00	194.96	0.00	0.00	0
Interests on deposits	9.82	0	0.00	0.00	-9.82	0.00	1	9.61	0	0.00	0.00	-9.61	0.00	0
Interests on loans	0.00	-4.88	0.00	0.00	4.88	0.00	1	0.00	-4.9	0.00	0.00	4.90	0.00	0
Interests on Area 1 bills	0.90	0	0.00	-19.28	14.77	3.02	1	0.60	0	0.00	0.00	0.00	0.00	0
Interests on Area 2 bills	0.61	0	0.00	0.00	0.00	0.12	1	0.87	0	0.00	-19.05	14.32	3.13	0
Change in money stock	0.00	0	0.00	0.00	0.00	0.00	1	0.00	0	0.00	0.00	0.00	0.00	0
Change in advances	0.00	0	0.00	0.00	0.00	0.00	1	0.00	0	0.00	0.00	0.00	0.00	0
Change in deposits	-1.58	0	0.00	0.00	1.58	0.00	1	1.02	0	0.00	0.00	-1.02	0.00	0
Change in loans	0.00	0	0.00	0.00	0.00	0.00	1	0.00	0	0.00	0.00	0.00	0.00	0
Change in Area 1 bills	-0.07	0	0.00	-0.54	-1.58	2.15	1	0.03	0	0.00	0.00	0.00	0.00	0
Change in Area 2 bills	-0.04	0	0.00	0.00	0.00	-2.15	1	0.01	0	0.00	1.16	1.02	0.00	0
Revaluation effects	0.00	0	0.00	0.00	0.00	0.00	1	0.00	0	0.00	0.00	0.00	0.00	0
Total	0.00	0	0.00	0.00	0.00	0.00		0.00	0	0.00	0.00	0.00	0.00	0

Notes: H = households; F = private firms; G = government; B = banks and financial intermediaries; CB = central bank; xr1 = exchange rate; 1 = Area 1; 2 = Area 2.

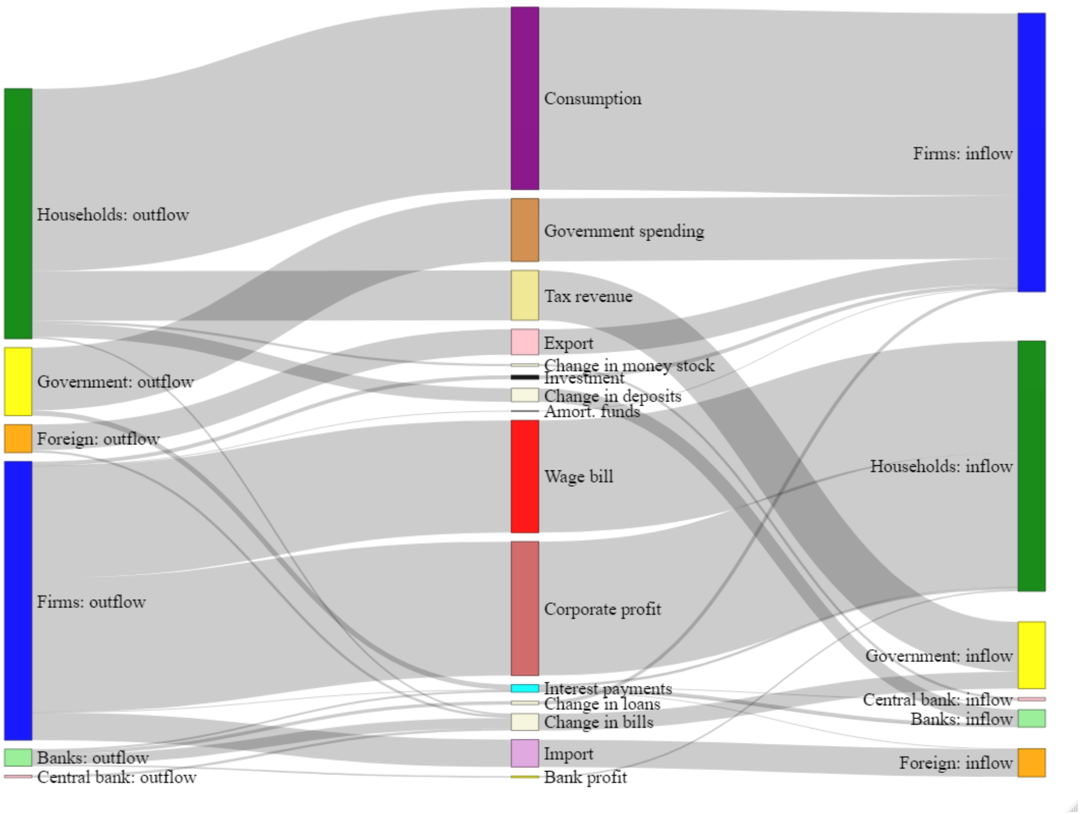

Figure 16.1 Sankey diagram of cross-sector transactions and changes in stocks in t = 20, single-country model

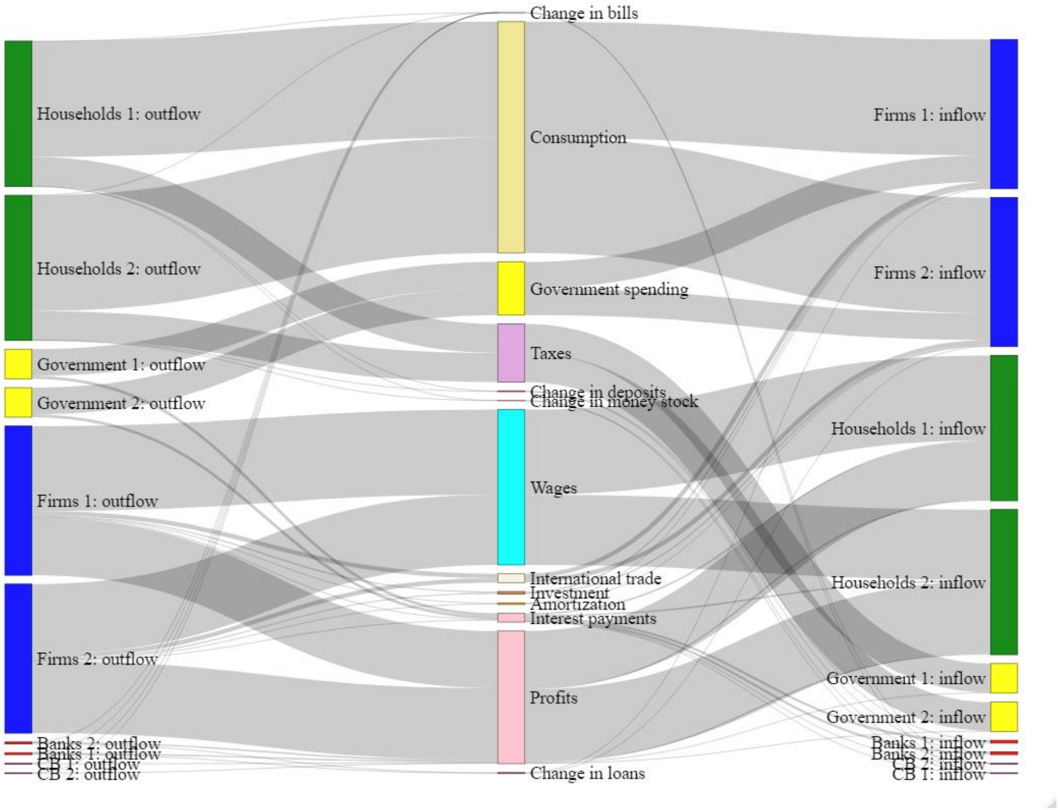

Figure 16.2 Sankey diagram of cross-sector transactions and changes in stocks in t = 20, two-area model

Table 16.5 Input-output matrix in period t = 20, single-country model, baseline scenario

	Manufacturing	Agriculture	Services	Recycling	Total	Final demand	Total output
Manufacturing (production)	67.72	67.70	67.74	0	203.16	248.31	451.47
Agriculture (production)	67.72	67.70	67.74	0	203.16	248.2	451.37
Services (provision)	67.72	67.70	67.73	0	203.15	248.41	451.57
Recycling (production)	0.00	0.00	0.00	0	0.00	0	0
Value added	236.48	236.43	236.53	0	709.45		
~ Compensation of employees	107.39	107.37	107.42	0	566.38		
~ G.O. surplus & mixed incomes	129.09	129.07	129.12	0	143.07		
Import (production)	11.82	11.82	11.82	0	35.47	-35.47	
Total output	451.47	451.37	451.57	0	1354.40	709.45	1354.4

Table 16.6 Extended input-output matrix in period t = 20, single-country model, baseline scenario

	Manufacturing	Agriculture	Services	Recycling	Total
Disposable labour income	85.91	85.89	85.93	0	257.74
Disposable capital income	105.60	105.58	105.62	0	316.79
Functional income inequality	0.19	0.19	0.19	0	0.19
Total employment	536.96	536.83	537.08	0	1610.87
~ Male employment	268.48	268.42	268.54	0	805.44
~ Female employment	268.48	268.42	268.54	0	805.44
Share of female employment	0.50	0.50	0.50	0	0.50
Waste production	220.90	220.87	220.92	0	662.69
Annual emissions of CO2	21.05	21.04	21.05	0	63.15

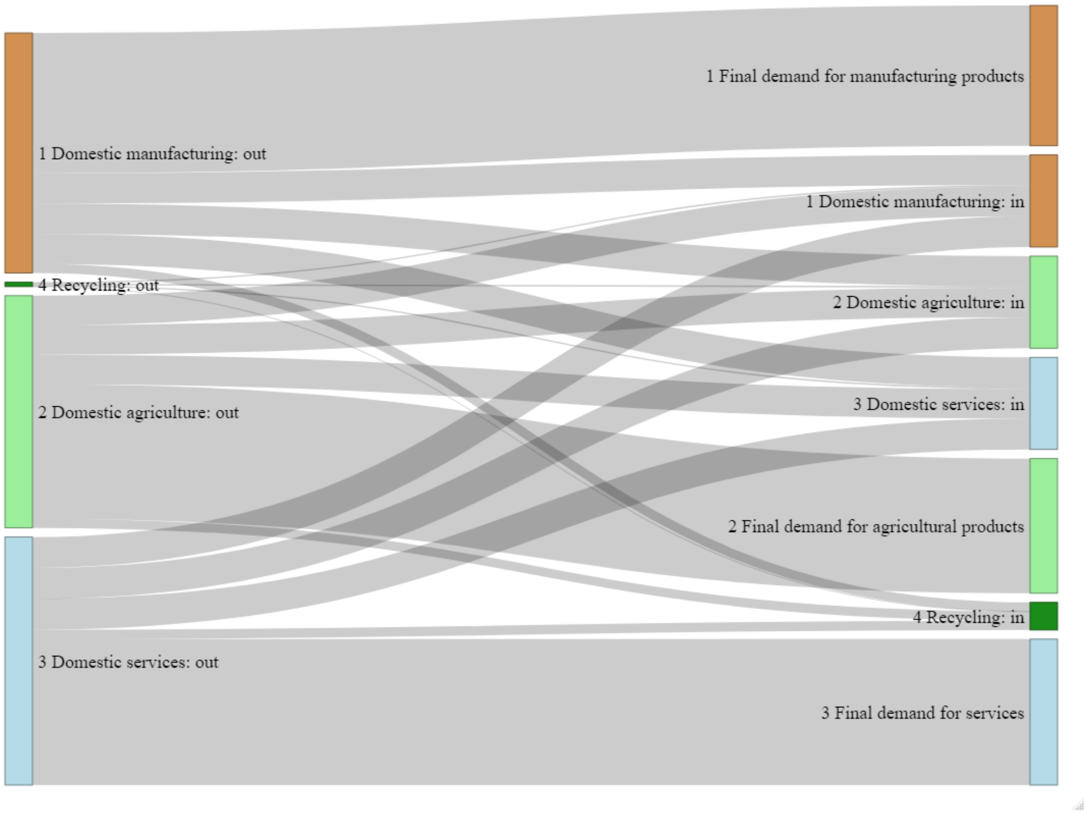

Figure 16.3 Sankey diagram of cross-industry input-output interdependencies in after CE innovation, single-country model

16.5 CE innovations in IO-SFC models: preliminary findings

The term 'circular economy' (CE) refers to a set of policies and practices aimed at reusing, repairing, sharing, and recycling products and resources to establish a closed-loop system, thereby minimizing waste, pollution, and CO2 emissions (Bimpizas-Pinis et al., 2021). One way to introduce a CE innovation in the aforementioned model is to consider a domestic economy with four industries. The first three industries produce goods and provide services (e.g., manufacturing goods, agricultural goods, and administrative services), while the fourth industry focuses on waste recycling. Specifically, a CE innovation involves changes in the matrix of technical coefficients, resulting in the following:

Reduction in the quantities of manufacturing and agricultural products and services used as inputs within the same industries.

Incorporation of recycled waste into the production processes of manufacturing and agricultural goods and the provision of services.

Utilization of manufacturing and agricultural products and services as inputs in the waste recycling industry.

Regarding the source of the shock, the model assumes that technical change (i.e., the new or target coefficients) is influenced by policy makers. Additionally, the average speed at which technical coefficients converge to their target values is defined as a linear, positive function of government expenditures (as discussed in Veronese

Passarella, 2022). In the following subsections, we will explore the implications of CE-oriented government spending in a single-country model and a two-area model, considering two different exchange rate regimes.

16.5.1 Single-country model

Figure 16.4 illustrates the impact of a CE innovation, triggered by increased government spending, on relative prices. Specifically, the adoption of new production techniques creates a fresh market for ‘recycled waste’, leading to a gradual increase in its unit price over time. In contrast, prices of other products and services decline. As expected, the combination of higher government spending and lower consumer goods prices results in an increase in real disposable income and consumption.

The improved production efficiency achieved using recycled waste as an intermediate good reduces the demand for traditional inputs such as manufacturing and agricultural products, as well as services. However, CO2 emissions initially increase due to the overall increase in output, including recycled waste. Nevertheless, the use of more efficient techniques and the lower energy intensity assumed in waste recycling eventually lead to a reduction in emissions compared to the baseline scenario, particularly in the long run when the net product stabilizes and total output even declines. In our preliminary experiment, the temporary nature of the rebound effect is specific to the chosen parameter values. Additional experiments demonstrate that the increase in CO2 emissions can be long-lasting (for a comprehensive discussion on rebound effects, refer to Zink and Geyer, 2017; and Bimpizas-Pinis et al., 2021).

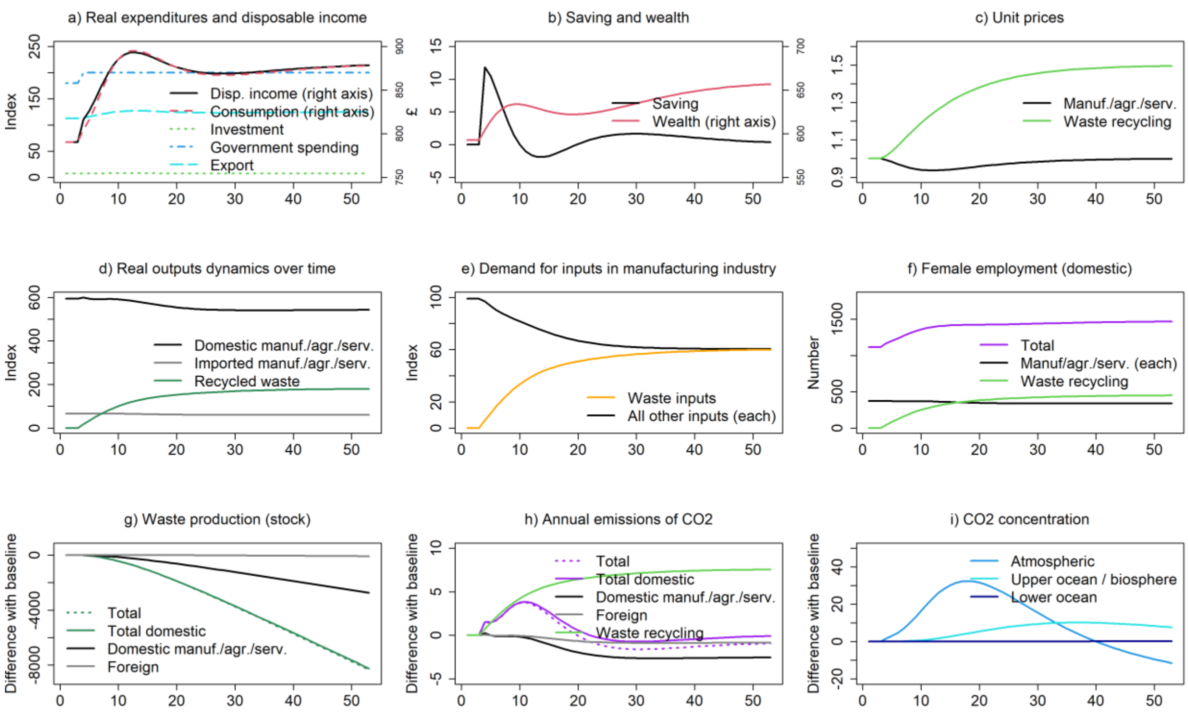

Figure 16.4 Selected variables after CE innovation, single-country model

Shifting focus to social variables, **Figure 16.5** reveals that, all else being equal, the functional income distribution becomes more favourable to workers due to two opposing effects coming into play. On one hand, the higher stock of government debt leads to increased interest payments to rentiers, which influences the wage share of total income. On the other hand, the recycling industry is assumed more labour-intensive than traditional industries, and this effect prevails. Gender income inequality, however, remains unchanged, although female employment increases in absolute terms. Once again, this outcome is driven by the higher labour intensity of the new recycling industry. Income inequality in terms of class and gender would increase in the case the new recycling industry had a lower labour intensity and a lower share in female employment.

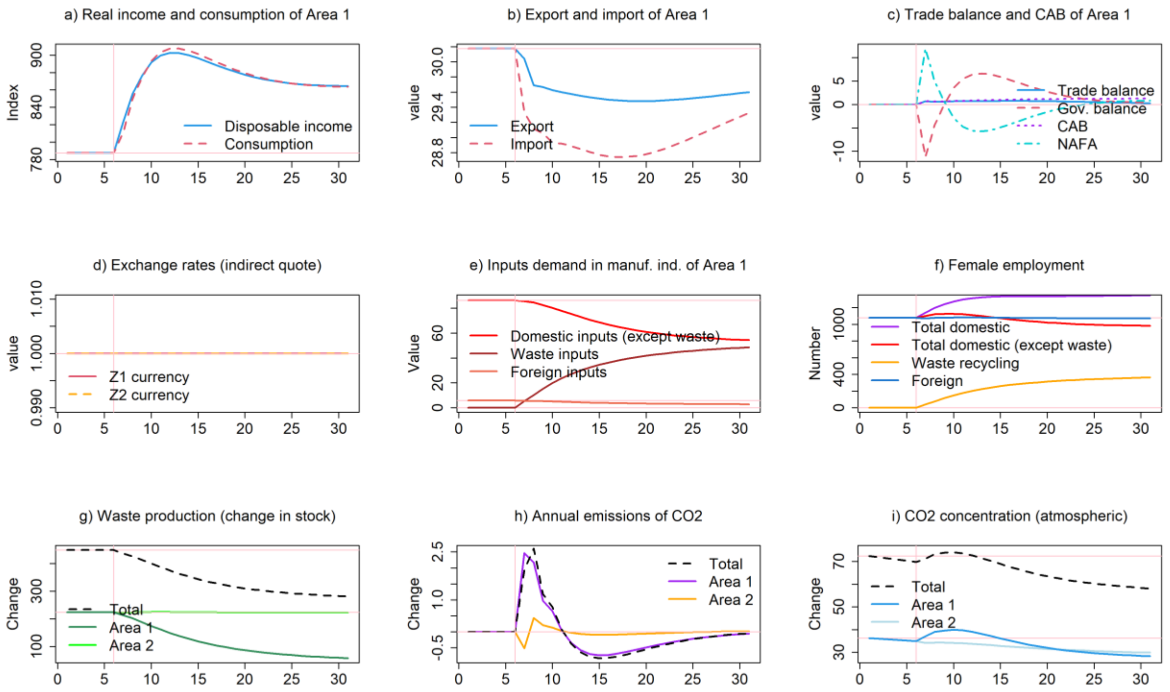

Figure 16.5 Selected variables after CE innovation, two-area model, fixed exchange rate

16.5.2 Two-area model with fixed exchange rate

Figure 16.5 illustrates the impact of a CE innovation triggered by increased government spending on selected variables in a 2-area economy model. The innovation only takes place in Area 1, and the currency exchange rate between the two areas is fixed: this scenario is critical as it applies to single-currency areas with regional economic diversity, such as the European Union, or the EU or the US with countries that maintain a fixed peg with the euro or the US dollar, such as Western Africa (e.g. the Financial Community of Africa, CFA) or China, Lebanon, Argentina, and Ecuador (which can also be considered as semi-floating in the next section). Despite the increase in government spending (quadrant (a)), the import of Area 1 falls sharply (quadrant (b)) due to the decline in the demand for (foreign) inputs due to the CE decrease in input requirements in production (quadrant (e)) and the trade balance becomes positive (quadrant (b)). The economy grows, and so does female employment, following total employment (quadrant (f)). The stock of accumulated waste reduces due to both recycling and the higher efficiency of domestic production processes (quadrant (g)). Despite the higher ecological efficiency, industrial CO2 emissions peak in the short run, although they fall below the initial level in the medium run (quadrant (h)). The same goes for CO2 concentration in the atmosphere (quadrant (i)).

16.5.3 Two-area model with (semi) floating exchange rate

Figure 16.6 illustrates the impact of a CE innovation in Area 1 when the currency exchange rate between the two areas is free to adjust based on cross-country trade and capital flows (semi-floating exchange rate regime). The main difference compared to the previous case is that, this time, the initial fall in imports (e.g. an improvement in the trade balance) leads to an appreciation of Area 1's currency (quadrant (d)) and a slight decrease in economic output (i.e. GDP). This new effect, in turn, affects exports negatively, so that the net trade balance actually becomes negative (quadrant (b)) despite the reduction in the demand for inputs from Area 2. Some minor differences in contrast to the fixed exchange-rate regime occur on both ecological and social variables: employment, waste, and emissions all grow less than they would have under a fixed exchange rate regime, due to the negative impact of currency appreciation on the trade balance and, consequently, the output of Area 1. It should be noted that this also implies a larger share of world production taking place in Area 2, the area that has not introduced any CE innovation. While this paradoxical effect is negligible in this simple example, it may have relevant implications when considering a more complex scenario (Carnevali et al., 2020). At this stage, the scenarios investigated are substantially stylised, so that the actual size of each effect will become clear when empirically calibrated with their actual values.

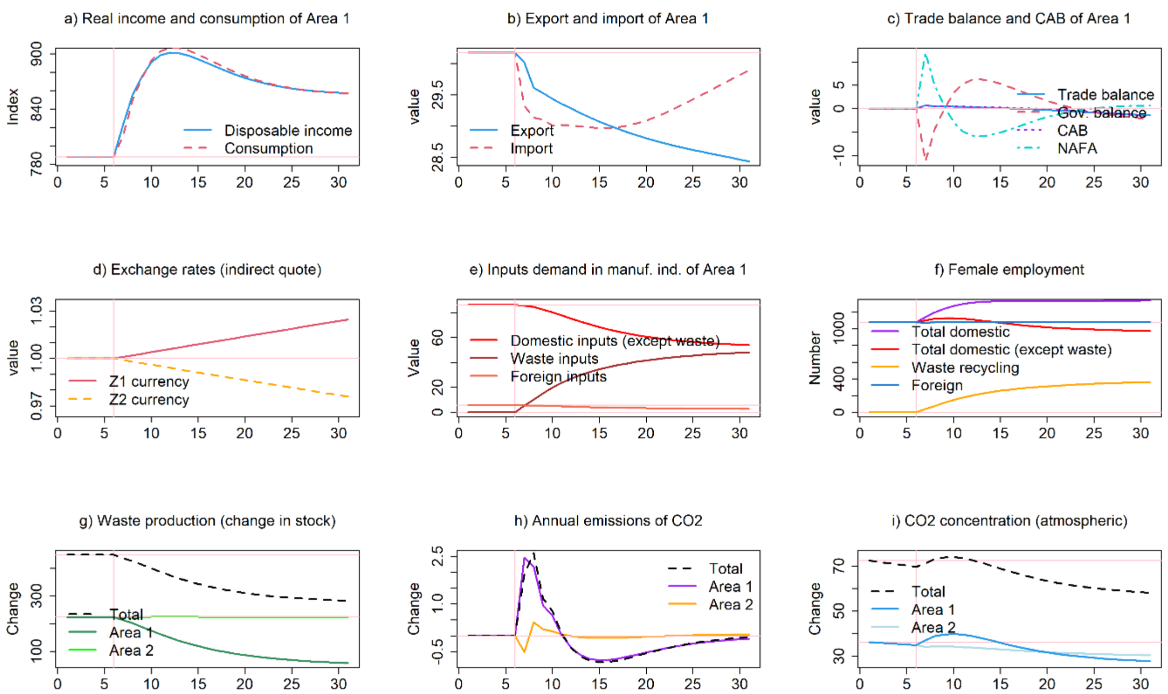

Figure 16.6 Selected variables after CE innovation, two-area model, floating exchange rate

16.6 Final remarks

The CE paradigm has gained momentum in both academic and industrial circles in the last decade. Despite the intuitive association of a transition towards a CE with a more sustainable society, there has been limited scrutiny about its economic viability. To address this, there is a need for macroeconomic tools to assess the impacts of CE policies on society, the economy, and the ecosystem. The field of ecological macroeconomics can fulfil this need through various promising modelling approaches. The aim of this chapter was twofold. Firstly, it provided a short overview of macroeconomic modelling developments addressing CE issues, focusing on the most widely used approaches and tools. Secondly, we argued that the combination of IO analysis with SFC modelling is one of the most promising methods to simulate, assess, and compare CE strategies. In order to support this, the main features of three IO-SFC models for a capitalist economy were presented and discussed. Unlike standard SFC models, the proposed models allow dealing with cross-industry interdependencies. Unlike traditional IO models, they allow endogenising technical innovations, by linking the changes in technical coefficients with other variables – such as policy decisions, the evolution of demand conditions, portfolio decisions, and the change in the ecosystem. As a result, a variety of feedback effects can be explicitly modelled. The simple exercises proposed here confirmed that the transition towards a CE system could not rely on higher production efficiency only, due to rebound effects. Its impact on social variables is also ambiguous, as it depends on several factors (such as foreign trade and financial flows), some of which are not under the direct control of the policy makers in a market economy.

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PART III. ROADMAP TO A JUST CE: KEY CONCEPTS, GEOGRAPHICAL AREAS, NATIONAL PATHS AND SCENARIOS

Chapter 17. Global Environmental Justice and Circular Economy

Teresa Meira, Giacomo D'Alisa

Abstract

This chapter explores the intersections between the circular economy (CE) and global environmental justice (EJ), examining both conceptual and empirical levels.

The chapter begins by acknowledging the contribution of EJ research in highlighting the unequal distribution of environmental costs caused by industrial social metabolism. It argues that for the CE to promote global EJ, a degrowth approach is necessary. Current research reveals that prevailing CE policies and practices generate social and territorial impacts similar to those of a linear economy.

Furthermore, empirical evidence demonstrates that different social actors perceive the CE differently, depending on whether it is mobilized by EJ organizations or by state and corporate actors. The chapter delves into a case study analysis of waste-pickers in Rio de Janeiro (Brazil) as a significant group involved in repair-reuse-recycle activities, particularly in the GS, providing crucial yet undervalued services to the CE.

In conclusion, the chapter proposes key recommendations for a just CE: 1) recognizing workers, both paid and unpaid, as primary stakeholders in the transition; 2) addressing cost-shifting issues and ensuring equitable distribution of costs during the transition; and 3) promoting inclusive decision-making processes that involve marginalized groups and give their perspectives equal consideration.

Keywords: Global Environmental Justice; Social Metabolism; Ecological Distribution Conflicts; Ecological Debt; Working Class Environmentalism

The problem addressed by this contribution is the potential for the circular economy (CE) to perpetuate global environmental injustice (EJ) due to its current formulations, which generate unequal social and territorial impacts. This study highlights the need to consider environmental justice and address historical inequalities in CE policies and practices.

17.1 Introduction

The JUST2CE consortium focuses on the idea that transitioning to a circular economy (CE) should prioritize justice in all aspects. The main objective is to explore how the CE model can be a sustainable and socially just alternative to the traditional linear economy. Achieving this goal involves examining the research on Environmental Justice (EJ) and identifying its connections with CE research.

While there is a larger body of literature on CE compared to EJ (around 18,000 entries versus 8,000 entries in Scopus[30]), EJ research actually predates CE research by about 15 years. The interdisciplinary field of EJ emerged in the United States in the mid-1980s, around the same time as the field of Ecological Economics. Scholars in both EJ and Ecological Economics have developed alternative theories that address the unequal and unsustainable impacts of material and energy flows associated with GDP growth on vulnerable communities and ecosystems (Martinez-Alier, 1987; Bullard, 1990).

It's worth noting that Kenneth Boulding (1966), one of the pioneers of Ecological Economics, wrote a paper titled "The Economics of the Coming Spaceship Earth." This paper influenced scholars D.W. Pearce and K.R. Turner, who were the first to use the term "circular economy" in their handbook of environmental economics (Pearce & Turner, 1990). Boulding criticized the linear "cowboy economy" and laid the foundation for research on the material balance of the economy (D'Alisa, 2019). Ecological economists have since demonstrated that viewing the economy as a linear system of endless expansion disregards the environmental limits and boundaries required for sustainable resource extraction and waste management (Daly, 1997). Concurrently, experts in Environmental Engineering, Innovation, and Technology Studies, specifically in the fields of industrial ecology and eco-design, have focused on practical research to enhance material efficiency and extend product lifespan. These efforts aim to address the ongoing demand for new resources and the urgent need to reduce the exponential growth of industrial waste (Ghisellini et al., 2016).

Since the early 2000s, a new approach to EJ has emerged, known as the Ecological Distribution Conflict framework. This framework, influenced by ecological economics, examines the unequal distribution of costs and benefits associated with the linear growth of the economy (Martinez-Alier, 2002). It specifically highlights the need to address environmental distributive injustice that is inherently linked to the "take-make-waste society" model. Notably, landmark literature focusing on waste conflicts and toxic disposal in impoverished, vulnerable, and racialized areas worldwide have played a crucial role in developing an EJ framework (Pellow, 2002; Pellow, 2007; D'Alisa & Armiero, 2012).

Both CE and EJ scholarship share two primary concerns: transitioning from a linear economic path to a circular one and addressing the escalating issue of industrial waste generation. However, the CE perspective often overlooks the unequal distribution of costs and benefits associated with the linear economy and potential transitions to a circular economy. For example, it fails to thoroughly consider how transforming the waste sector will impact different actors involved in formal and informal waste management globally. This partial neglect helps explain why CE and EJ scholars have not extensively incorporated each other's research findings, despite having ample opportunities for collaboration. Bridging this knowledge gap necessitates a comprehensive exploration of EJ theories developed over the past three decades and identifying the most relevant conceptual tools for CE research and policy.

[30] Retrieved in September 2022

17.2 Global Environmental Justice: a conceptual toolbox

The EJ scholarship originates in the second half of the 1960s in the anti-toxic struggles of Black, Latino, and Native American communities in the U.S.A. (Bullard, 1993; LaDuke, 1999). The concept of EJ embodied community-led expertise that demonstrated the correlation between sites of pollution disposal and exposure, racial discrimination, and poverty. Statistical evidence of the existence of "environmental racism" was thus established via social science research (Bryant & Mohai, 1992), giving rise to a new body of scholarship, which has produced detailed analyses of the unequal distribution of social and environmental costs between different social groups.

This section introduces a conceptual toolbox with four key concepts related to framing the CE within the context of EJ: 1) social metabolism; 2) ecological distribution conflicts; 3) climate and ecological debt, and 4) working-class environmentalism.

The concepts covered are as follows:

1. Social Metabolism: Refers to the material and energy flows necessary for the functioning of societies. It highlights the connection between economic growth, industrial social metabolism, and the unequal distribution of environmental costs across social groups and regions. According to Martinez Alier (2012), addressing inequalities related to environmental justice requires an alliance between the concept of "degrowth" in wealthier nations and the "environmentalism of the poor" from regions in the GS.
2. Ecological Distribution Conflicts (EDCs): EDCs arise from the unequal distribution of benefits and costs related to the use of the biophysical environment. The Environmental Justice Atlas (EJAtlas) is an essential inventory of these conflicts, involving indigenous communities, rural populations, and marginalized workers (Temper et al., 2015). EDCs demonstrate that the current formulations of the CE can perpetuate global environmental injustices.
3. Ecological and Climate Debt: Signifies the unequal distribution of costs and benefits resulting from the increase in social metabolism between the GN and South (Martinez-Alier, 2020). It stems from historical and present resource plundering, waste disposal, and ecological damage caused by colonizing countries (Pigrau et al., 2014). Reparations for ecological and climate debt are demanded, highlighting the need to reformulate the CE as a response to ecological unsustainability and as a means of debt repayment.
4. Working-Class Environmentalism: From an EJ perspective, the working class can be defined as "those who make a living out of physical work performed in agriculture, industry or service, typically occupying the bottoms of the labour hierarchy, i.e. the lowest paying, highest risk jobs" (Barca 2012:2). Explores the environmental agency of workers engaged in struggles to defend both the environment and their labor conditions. It emphasizes the environmental injustices faced by working-class communities and recognizes the diverse actors involved in GEJ movements, including women, racialized individuals, and those in unwaged or informal labor.

These concepts provide a foundation for understanding the intersections between CE and EJ in a global context, and highlight the need to address social and environmental inequalities in the pursuit of a just transition to a circular economy.

17.3 Methodology

This study was conducted in three phases: a bibliometric analysis and literature review, an analysis of empirical data from the EJ Atlas, and complemented with a case study analysis.

For the bibliometric analysis, we searched the Scopus database, which contains a large collection of research papers. We looked for documents that discussed both the CE and EJ in their titles, abstracts, or keywords. After filtering out the results, we identified a set of 11 relevant documents. Using bibliometric software (VosViewer), we analyzed the connections between different items mentioned in these papers, such as keywords and concepts. This helped us identify clusters of related topics within the literature, and understand the distribution of topics and research trends within the fields of CE and EJ. By examining how often certain keywords appear together in different papers, we gain insights into the relationships and structures within these research areas.

We conducted a co-occurrence analysis to examine the relationships between concepts based on bibliographic data such as journals and scientific areas. We assigned different colors to clusters of keywords, and the size of the circles represented their frequency in the dataset. The strength of the links between keywords indicated how often they appeared together in the same papers (**Figure 17.1**).

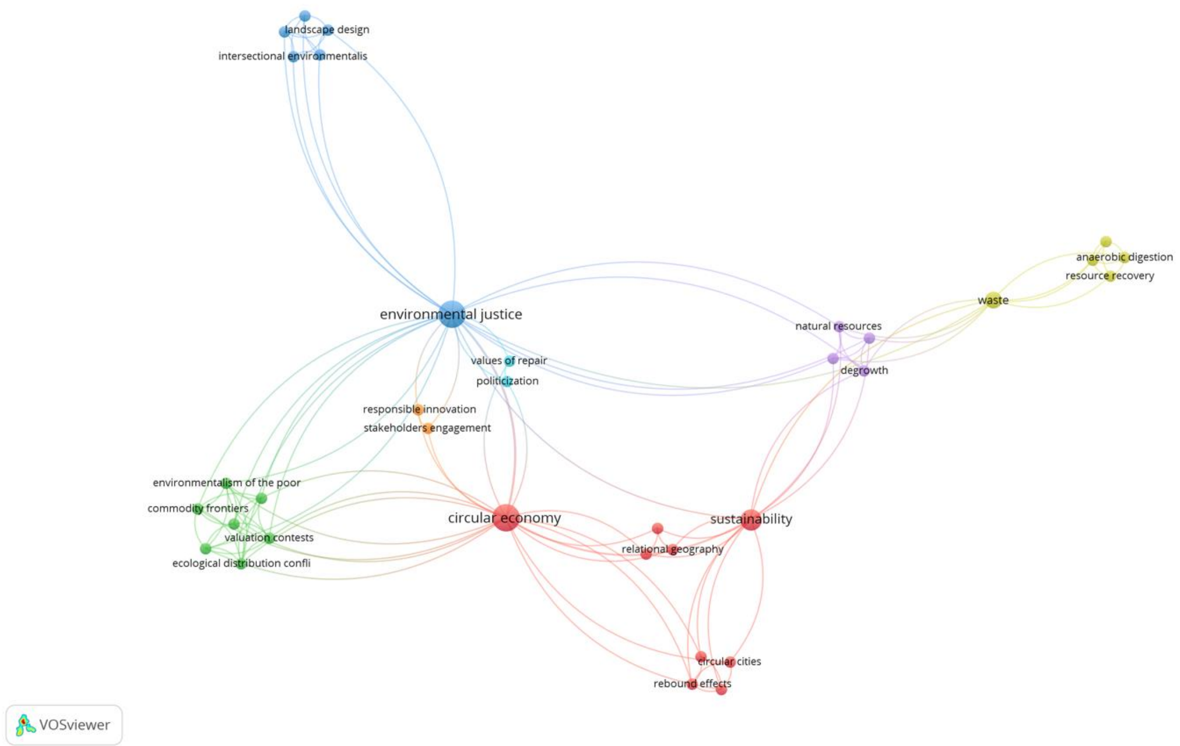

Figure 17.1 Bibliometric network based on keywords

After the bibliometric analysis, we proceeded to conduct a critical review of the selected papers (**Table 17.1**). We qualitatively and analytically grouped them based on concepts such as social metabolism, environmental conflicts, ecological/climate debt, and working-class environmentalism. This allowed us to explore the intersection of labor, gender, and just transition, which has been largely overlooked.

Table 17.1 Selected papers from Scopus database

#	Title	Authors	Year	Source

1	“Nobody” matters in circular landscapes	(Wuyts & Marin, 2022)	2022	Local Environment
2	Scientists’ warning against the society of waste	(Marín-Beltrán et al., 2022)	2022	Science of the Total Environment
3	Mapping ecological distribution conflicts: The EJAtlas	(Martinez-Alier, 2021)	2021	Extractive Industries and Society
4	Future-proofing capitalism: The paradox of the circular economy for plastics	(Mah, 2021)	2021	Global Environmental Politics
5	Clarifying rebound effects of the circular economy in the context of sustainable cities	(Chen, 2021)	2021	Sustainable Cities and Society
6	Repair for a broken economy: Lessons for circular economy from an international interview study of repairers	(Niskanen et al., 2021)	2021	Sustainability (Switzerland)
7	Politicising Circular Economy: what can we learn from Responsible Innovation?	(Pansera et al., 2021)	2021	Journal of Responsible Innovation
8	The trilemma of waste-to-energy: A multi-purpose solution	(Malinauskaite & Jouhara, 2019)	2019	Energy Policy
9	Conceptualizing waste as a resource: Urban biosolids processing in the rural landscape	(Mason-Renton & Luginaah, 2018)	2018	Canadian Geographer
10	Interrogating the circular economy: the moral economy of resource recovery in the EU	(Gregson et al., 2015)	2015	Economy and Society
11	Waste Picking as Social Provisioning Constructing a Socially Regenerative Circular Economy	(Velasco et al., 2021)	2021	Academy of Management 81st Annual Meeting (26 July 2021): 1-6.

In addition to the bibliometric analysis, we also explored empirical data using the Environmental Justice Atlas database (https://ejatlas.org/). This database is the result of collaboration among scientists, citizens, and activists and documents cases of environmental conflicts. These conflicts are categorized based on the type of activity involved, such as nuclear, mineral extraction, waste management, and more. The EJ Atlas allows filtering and browsing the cases based on various criteria, providing valuable insights into the dynamics of environmental justice.

17.4 Results

Out of the 3740 cases in the EJ Atlas, only 13 mentioned the Circular Economy in their descriptions or as an alternative solution[31]. By analyzing these case studies, we aimed to understand how the concept of CE is integrated into public policies, business criteria, or proposals from environmental justice organizations and affected communities.

We present the main features of the selected cases according to three criteria: 1) if CE is being mentioned as part of a policy goal proposed by public authorities; 2) if it's presented as a business solution, or 3) if it is emerging as an alternative proposed by the communities/EJOs.

We are aware that this result is not a representative sample, for example, the overrepresentation of China cannot be used as a conclusion for how CE practices are more relevant there. Nevertheless, this sample is a useful entry point into the different ways in which CE intersects with EJ mobilizations.

These cases are distributed across different regions: seven in Asia (China), two in Africa (Tunisia and Mozambique), one in Europe (Poland), two in North America (Canada), and one in South America (Argentina).

Out of the thirteen cases, eight are classified as waste management conflicts, two as mining conflicts, and three as fossil fuel extraction conflicts. However, upon examining the specific conflict types, it becomes apparent that all of them have a direct relation to waste. Mining conflicts involve landfills, toxic waste treatment, and uncontrolled dumpsites, while fossil fuel conflicts are associated with emissions.

The analyzed conflicts range from 2009 to 2020, with only four of the thirteen cases having been updated within the 2022. It is noted that time is an important factor in analyzing the EJAtlas, as temporary wins can sometimes result in permanent losses. Projects may eventually be approved if protests subside or new legislation is ratified, even after years of opposition from Environmental Justice Organizations (EJOs).

It's important to note that the EJ Atlas is a complementary knowledge tool that enriches our understanding of the justice dimension in the CE. While the EJ Atlas may have representation biases and not capture all relevant cases, we acknowledge these limitations and provide in the next section a discussion of a case study that is not referenced in that database but also highlights the global environmental justice challenges associated with the transition to a CE.

The case of waste-pickers in Rio de Janeiro – Brazil

The study of waste-pickers32 in the GS can bring important insights to the discussion about how circular activities already in place are not recognized as such, and how they can be jeopardised by the implementation of CE policies. Waste-pickers are important enablers of sorting, repairing and recycling activities, not to mention the environmental services conveyed by them. In Brazil they represent 1 million workers (MNCR, 2022); in India, this activity represents 1% of the informal sector, which means around 2 million workers; in Ghana, waste-picking is one of the top 5 occupations in the informal sector. Generally speaking, waste-pickers form a numerous workforce in countries where the large majority of workers are informally or self-employed (WIEGO, 2020). In this section, we draw from previous research (Meira, 2017) to offer an overview of a CE-related environmental conflict involving informal waste-pickers in Brazil.

In the background of this case is the landslide in a waste dumpsite inside Morro dos Prazeres,a favela in the center region of Rio de Janeiro, Brazil, that killed almost 50 people in 2010 (IAI, 2010; Meira, 2017). This tragic incident was followed by a series of protests drawing attention to the severe risk the location was under, and the potential equivalent episodes that could happen due to the same reasons – the accumulation of huge quantities of solid waste in a number of areas within the favela. In that same year (2010), the Brazilian National Policy on Waste was published and included important changes in the legislation, among which: the formal recognition of waste-pickers as workers; the obligation to include those workers in the municipal waste management plans; and the obligation to shut down all the illegal dumpsites in Brazil. The new regulatory framework introduced the principle of shared responsibility for the life cycle of products, a CE-like policy, and highlighted the need to include waste pickers as “agents of change". Their service and “economic emancipation" should have been considered as a priority in the municipal waste management plans.

The National Movement of Waste-Pickers, founded in 2001, offered fundamental support to the workers impacted by the national policy. In fact, the actions undertaken by the government in implementing the new policy left many waste-pickers behind, either by restraining access to the dumpsites (and therefore the recyclables), or by imposing the high costs of formalisation upon the workers themselves (e.g. health insurance and insalubrity costs), resulting in an insufficient inclusion of these workers in the municipal waste management plans.

In Rio de Janeiro, ¼ of the total population lives in favelas, home of most waste-pickers. In addition to the high population density, dwellers are subject to eviction threats, and to the drug traffickers and paramilitary factions that control the supply of basic services (e.g. electricity and gas). After the 2010 landslide, a women-led movement in the Morro dos Prazeres community founded an organisation called “Reciclação", which resorted to collective action to encourage the participation of residents in the waste sorting and environmental preservation of the favela. The financial support came from both the state and the private sector, the organisation achieved much higher rates of separation of recyclable materials than the rest of the city (71% against 3%) (Meira & Muradian, 2016).

[32] For the purpose of this chapter we use “waste pickers” as general term to represent the workers in the waste sector as defined by the International Alliance of Waste Pickers: “a) individuals involved in the collection, segregation, sorting, and sale of recyclables in an informal or semi-formal capacity as own-account workers; b) itinerant waste pickers, informal/semi-formal waste collectors engaged in transporting, sorting, and selling recyclables, informal workers informal workers engaged in transporting or sorting within the informal or semi-formal sorting/recovery/recycling sector, or any of the above who are integrated into municipal waste management systems and continue to sort and sell recyclables; c) Former recyclers who occupy new roles in their recycling organisations in environmental promotion, caregiving, health programs, gender programs, etc.” (p.1, Globalrec, 2022).

The uneven distribution of the costs and benefits of public services allows us to characterise favelas as "sacrifice zones" (Bullard, 1994). As the workforce with the lowest income is concentrated in these territories, the environmental loads tend to be concentrated there (Cunha et al., 2015); in some cases, such as that of the Morro dos Prazeres, this spatial injustice causes the emergence of "working-class environmentalism". In this case, a women-led, bottom-up model of CE involving waste pickers and local cooperatives was developed - even though it has not been officially recognized as CE.

17.5 Discussion

The literature on the intersection of CE and EJ has focused on several key topics, including cities, rebound effect, commodity frontiers, territorial approaches, recycling and waste, degrowth, politicization, and responsible innovation. However, rather than indicating a common approach, these themes reflect the fragmented and dispersed nature of the literature. The articles cover a wide range of topics and utilize different case studies, often at incompatible geographical scales (local, national, and global). Furthermore, they are published in diverse scientific journals, drawing on heterogeneous pieces of literature.

Geographically, the fragmentation of the EJ/CE debate is evident. Some papers adopt a global scale and examine various objects such as waste increase, environmental conflicts, plastic recycling, and machine repair work. Other papers focus on specific regions or local scales within countries, while some articles have a theoretical or conceptual dimension without specific geographical references. Due to the wide scattering of these texts, it becomes challenging to compare them as they differ significantly in terms of geographical basis and topic.

In terms of journals and literature mobilization, there is also a significant fragmentation. The papers can be classified into three main fields: social sciences, management and innovation, and sustainability and environmental science. Each field has its own methodological requirements and approaches to the transition. While some articles within each field share common references, others have no overlap with any other article. The literature fragmentation is apparent in the diversity of journals and approaches utilized.

Despite the dispersion of references, there are some common points that can be analyzed comprehensively. The encounter between CE and EJ emerged relatively recently, with articles focusing on topics such as global social metabolism, consumption patterns, waste, and the inclusion of informal CE actors. The unequal impacts of CE policy implementation strategies and the expansion of waste disposal frontiers are also recurring themes across the papers.

It is worth noting that the main topics addressed in this literature directly align with the conceptual toolbox presented in the first section, including global social metabolism, inclusion/invisibilization processes, unequal impacts of CE policies, and EDCs.

The selected articles in this section provide a critical analysis of the intersection between EJ and CE. They highlight the absence of justice concerns in the CE literature and explore how concepts such as social metabolism, ecological debt, ecological conflicts, and working-class environmentalism could be integrated into CE debates.

One perspective presented by Martinez-Alier (2021) argues that achieving a fully circular economy is impossible due to the reliance on economic growth, which leads to increased extraction, pollution, and waste. Only a circular economy based on degrowth can be socially and environmentally just. This challenges the techno-optimistic view of CE and emphasizes the need to address environmental justice concerns.

The literature review also addressed questions about the role of technology in addressing the ecological crisis. While some articles suggest that new technologies like waste-to-energy can contribute to the circular economy, concerns are raised about the potential negative impacts. For example, the use of patented technology like the Home Energy Recovery Unit may exacerbate social inequalities and lead to rebound effects where increased individual waste processing may result in more overall waste.

The concept of justice is explored in the context of CE, with some articles highlighting the importance of recognition, distributive justice, procedural justice, and restorative justice. In particular, Wuyts and Marin (2022) discuss how the CE can perpetuate social inequalities if it fails to recognize the diverse social identities of stakeholders and value certain activities practiced by marginalized groups.

The review also addresses the need to recognize and analyze social and environmental conflicts in the context of CE. This dimension is often overlooked in the literature, but understanding conflicts over resource access, use, and distribution is crucial for achieving environmental justice.

Lastly, the perspective of working-class environmentalism is discussed, emphasizing the importance of repair and challenging the dominant focus on recycling in the CE discourse. The political and social dimensions of repair are highlighted, and the need to consider existing autonomous circular practices that are not profit-oriented.

Overall, this critical review of the literature on CE/EJ intersections highlights the need to incorporate justice concerns, address social and environmental conflicts, and recognize the diversity of stakeholders and practices in the pursuit of a more sustainable and just circular economy.

The EJ cases found in EJ Atlas showed that in terms of CE as a policy goal, China stands out as a country that has implemented CE models to address issues like waste management, resource efficiency, and low-carbon cities. However, conflicts have arisen due to conflicts with local communities, as seen in cases such as the Guiyu National Circular Economy Industrial Park and the Asuwei waste incinerator. These conflicts highlight the importance of considering EJ in CE policy implementation.

There are also cases where CE is presented as a business solution. In Tunisia, a public-private partnership was established to integrate the informal waste sector into municipal solid waste management, with the goal of realizing a circular economy. In China, the Chenjiachong landfill site and the proposed waste-to-energy plant project aim to address waste management issues through a circular economy approach. However, these projects are still under negotiation and face opposition from local communities. It is important to notice that the CE models found in the Atlas , that address CE both as business solution and as policy goal, are based on technocratic approaches and their main goal is resource efficiency.

EJOs have also made claims related to CE. In Canada, EJOs mobilized against mining projects in Quebec, proposing CE as a solution to limit the impacts of the transport electrification process. The cases of Nouveau Monde's Matawinie graphite mine and Sayona Mining's Authier Lithium Project demonstrate how EJOs advocate for social acceptability and the reduction of environmental impacts through CE approaches.

Furthermore, EJOs in Mozambique and Argentina have used CE to highlight the importance of integrating informal waste workers into the formal waste management system and recognizing their contributions to CE. The cases of the Hulene Dump Site protests in Mozambique and the ban on animal-drawn carts in Berazategui, Argentina, shed light on the struggles faced by waste pickers and their demand for social inclusion and recognition.

The case study of waste-pickers in Rio de Janeiro, Brazil, underscores the critical role these workers play in the context of CE policies and are not recognized as such. The landslide tragedy exposed the complex dynamics of inclusion and exclusion of non-value-based circular practices, and spatial injustices in working-class environmentalism.

Overall, these cases illustrate the complex intersections between CE and EJ, highlighting the need for inclusive and equitable approaches to CE implementation that consider local contexts and address EJ concerns.

17.6 Conclusions

The current formulations of the CE have two major shortcomings:

1. The transition to CE can result in unequal distribution of benefits and costs, impacting different groups due to existing power asymmetries and historical injustices. Without addressing these inequalities, new conflicts may arise. CE policies must consider social dimensions and historical injustice to achieve a just transition.
2. Many circular activities, such as informal repair, waste picking, and unpaid reproductive work, are not recognized as part of the CE. These activities contribute to waste reduction and circularity but are excluded from CE design and policies. This exclusion perpetuates colonialism of knowledge and disregards sustainable practices that have never been described in circular terms.

In summary, mainstream CE models focus on resource efficiency and technocratic projects, while non-value-based circular practices remain unnoticed. This includes subsistence-oriented practices, unpaid labor, and marginalized workforces. To achieve a just transition to the circular economy, it is crucial to recognize and include these overlooked aspects.

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Chapter 18. The relevance of gender justice: How gender is shaping sustainability and circular economy

Bibiana Martínez Álvarez, Andrea Jimenez

Abstract

Through approaches such as Feminist Ecological Economics (FEE) and Gendered Innovation (GI), and specific examples based in concrete case studies we will try to address: 1) What gender and gender justice means and 2) how gender is shaping sustainability and Circular Economy (CE), and what are the implications of this to dimensions of justice. The two mentioned approaches allow a broader definition on gender justice: FEE through a deep and intersectional discussion of economic valuation mechanisms and GI through gender considerations throughout the research process. To illuminate these approaches to circularity and justice in terms of gender we will introduce two case studies based on non-corporate, i.e. community-oriented CE practices developing what we call a value transformative approach to CE (a community composting in New York City and reuse communities in Maine). Finally, since these two examples and others that we found in the literature review are contextualized in GN we add a final subsection discussing the importance of addressing CE experiences from the GS with a decolonial perspective.

Keywords: Gender justice, circular economy, sustainability, gendered innovation, feminist ecological economics

Our aim in this chapter is to investigate the meaning of "gender justice" for the CE and to offer conceptual tools for expanding our understanding of gender in the context of CE.

18.1 Introduction

The basic question we want to tackle in this chapter is: how is gender shaping the CE and what are the implications of this to dimensions of justice?

To address this issue we need to clarify first what gender and gender justice means. First, gender is not a synonym for the female sex, but a social construct which determines norms and expectations about people's position in society, and about their behavior. Social norms shape social performance, including the division of labour in society, and economic valuation (Martínez Álvarez and Barca, 2023). Moreover, women are an internally differentiated category, intersected by class, race/ethnicity, ability and other differentiations.

Gender justice is understood as an approach aimed at tackling the discrimination of women as they intersect with various different lived experiences. This involves unpacking the root causes of gender discrimination and of unequal valuation, as well as an understanding of how other intersecting categories are shaping the CE and women's position in it. Consequently, gender justice does not coincide with gender equality and can only be achieved by taking all of these factors into account.

In Feminist political economy, gender is understood as a function of the social division of labour – that is, of the division between so-called productive and so-called reproductive or care work. This division determines the value attributed to each type of work, and their association with specific social groups. In other words, in most societies a patriarchal value system predominates, which consists in devaluing reproductive work and assigning it to women. This means that the social division of labour comes with not only gender differentiation, but also with a broader set of social hierarchies. Devalued reproductive work is typically associated with women who find themselves in the lower position in these other social hierarchies.

This perspective is crucial when looking at dimensions of justice, given that the most common approach in economic policies and planning is that of overlapping gender with women, where 'women' are understood as a pre-determined and homogeneous category. And so, the findings from one group of women can get generalised to all women, and have detrimental impacts for gender justice. Thus, the category of gender requires careful consideration in research and practice.

Approaches like gendered innovation focus on including gender considerations throughout the research process, from the formulation of the research questions, methodologies, data collection, interpretation, and application. According to scholars, projects that focus on gendered innovation have a number of advantages for disciplines "by ensuring excellence and quality in outcomes and enhancing sustainability and adds value to society by making research more responsive to social needs."

Although gendered innovation approaches would also be championed for how it can lead to technological and scientific breakthroughs (Schiebinger, 2021), our focus on this chapter is on how gendered innovation, as a framework for embedding gender throughout the research process, could be a useful tool if it was coupled with a justice approach.

We start with a broad review of the larger sustainability agenda and how gender has been framed within this discourse, to then unpack gender in the CE. We illustrate the multiple ways in which gender can be approached, and our focus on feminist ecological economics as the framework for incorporating dimensions of justice. We then present some examples of CE experiences that can shed light into what a gender justice approach to CE would look like in practice.

18.2 Literature review

Our literature review search strategy was based on three dimensions. First, we drew on a previous literature review for the gender justice report elaborated for the JUST2CE project. This literature review was based in a search of Feminist Ecological Economics (FEE) documents, but also in articles who related CE with gender and care in their tittle, abstract or keywords. We searched for these concepts in relevant databases such as WOS or SCOPUS but also in specific journals, such as Feminist Ecological Economics or Ecological Economics Journal. Second, we also wanted to broaden the scope of this chapter by connecting the gender dimension in CE with the broader notion of sustainability. Our notion of sustainability was informed by the Sustainable Development Goals (SDG's), so we searched for studies that looked at literature on the gender dimension within the SDGs. We then complemented this with the notion of gendered innovation, as a framework for embedding gender throughout the research process.

18.3 Sustainability and gender

The agenda for sustainability and the attainment of the Sustainable Development Goals (SDGs) have become a global priority, influencing policy and planning for decades (Connelly, 2007). The United Nations defines sustainability as a multidimensional and integrated approach to addressing environmental challenges alongside socioeconomic development . Due to their all-encompassing nature, the SDGs and broader sustainability agenda have been a concern across countries, industries, and fields, including the more traditional environmentalist and development disciplines as well as engineering, physics, data science, and more (Leavesley et al., 2022).

The SDGs and broader agenda for sustainable development have also been at the centre of more recent theoretical approaches to sustainability, including the circular economy (Schroeder et al., 2019; Suárez-Eiroa et al., 2021). For some, the circular economy has emerged as the most important concept for achieving the SDGs, as it is viewed as providing market-based, technological, and political solutions (Alonso-Almeida et al., 2020). In addition, it seeks to be fit for transforming both public policy and offer individualised solutions to local sustainability challenges. Overall, a synergistic relationship appears to exist between sustainability and the circular economy.

Although the SDGs and sustainability agenda seek to examine multiple dimensions, there are certain transversal tenets that can be found throughout the targets and indicators. Issues such as a focus on impoverished populations, the focus on the GS/developing nations, and inclusive practices are reiterated frequently throughout the SDGs. Amongst there, gender is a cross-cutting theme. Not only is SDG 5 wholly concerned with achieving " gender equality and empower all women and girls" (UN, 2015 14), but the SDGs' discourse places a strong emphasis on gender as a cross-cutting theme (Leal Filho et al., 2022). The global goal for SDG 5 is to achieve gender equality, and to empower women and girls by eliminating gender disparities, discrimination, and violence against women (UN, 2015).

The SDG5 focuses on reducing and eliminating all forms of discrimination and violence against women and girls (5.1, 5.2, 5.3), recognising and valuing unpaid care and domestic work (5.4), and ensuring that women have equal economic opportunities and access to healthcare (5.5, 5.A, 5.6). These objectives illustrate a variety of intervention areas. The remaining targets (5.B and 5.c) place a greater emphasis on empowering women and girls through the improvement of digital technologies and the promotion of sensible policies. In addition to these, there are 45 gender-related SDG targets and 54 indicators (Filho et al., 2022).

While the inclusion of a gender element in the Sustainable Development Goals (SDGs) is a significant step towards addressing gender inequalities, it is important to note that the emphasis is frequently placed primarily on women's empowerment and leadership, as it is assumed that this will have positive effects on individuals, communities, and nations (Odera & Mulusa, 2020). Less attention is paid to how the SDGs could resolve the structural factors that have historically perpetuated gender disparities (Esquivel 2016). Indicators for measuring the impact of SDG 5 include "number of women in political positions" and "number of women in managerial positions," among others. It also encompasses "mobile telephone ownership" and "female lands rights and ownership." These indicators indicate a strong emphasis on attaining gender equality by ensuring that women have the same opportunities as men to attain economic stability and power positions (Struckmann, 2018).
By focusing primarily on women's empowerment and leadership, the gender component of the SDGs risks regarding gender as an individual issue as opposed to a structural issue that seeks to challenge patriarchal norms and oppressive systems (ibid). Importantly, it suggests that the emphasis should be placed on transforming women rather than systems. Much of this represents a liberal/neoliberal approach to gender that has been extensively critiqued by feminist scholars.
Moreover, another issue lies within the notion of gender. Scholars have argued that the SDGs run the risk of homogenizing women and girls' experiences. Some have called for the need to disaggregate data to make it more representative of the diversity of women's experiences across the world (Devakumar et al., 2023).

A broader approach to sustainability and gender: Feminist Ecological Economics

Feminist Ecological Economics (FEE), has systematically linked the ecological crsis with gender inequalities, specifically the devaluation of reproduction (i.e. not taking into account reproduction as an essential element to reproduce societies and their environment, and for market production.). From this perspective, the concept of sustainability is discussed with a critical approach that questions the neoliberal framework of sustainable development, which promotes GDP growth as the only way to achieve prosperity, despite the fact that this ignores the foundations of every eco-system. (Waring, 1988; Gottschlich and Bellina, 2017; O'Hara [1999] 2010; Berik 2018).
In fact, by adopting the lens of reproduction and care work, the relationship between human beings and the biosphere appears substantially different than when focusing on production or consumption. When the production of / care for people is connected with the production of / care for healthy environments, the positive, i.e. nurturing, restoring, repairing and life-sustaining potential of housework becomes evident.
This positive link raises the question of bringing care work center-stage in sustainability, and thus in CE practices and policies. It also raises the question of how to organize environmental care in gender-equal terms so that it does not fall exclusively upon women's shoulders (Paño Yanez, 2021). According to Gottschlich and Bellina (2017), the mainstream sustainability discourse has failed to address the structural significance of (unpaid) care work, not only for the economic system but also for the reproduction of society as a whole. They argue that sustainability needs to be based on a "critical-emancipatory" conceptualization, driven by environmental justice and feminist political economy.
Since the late 1990s feminist ecological economists noted how Quality of Life indicators also continued to ignore social and environmental sustainability (O'Hara, 1999; Gottschlich and Bellina, 2017; Berik, 2018; Streimikiene

2015). From a FEE perspective, the dominant discourse on sustainability neglects the crisis of social reproduction, as well as the “interconnectedness” between the spheres of production and reproduction. In other words, human, social and ecological reproduction is necessary to develop the productive dimension intended as formal employment in the market. For this reason, some authors find it pertinent to bring up the concept of “sustainability of life”. This concept allows us to overcome the boundary between the monetized economy and. the devalued care work and the ecosystem functions (Dengler and Lang, 2022: 7) and to consider social and biological reproduction as key elements of sustainability. “Sustainability of life” is related to notions such as good life or well-being, hence also to the Buen Vivir conception so important in Latin America. The demand for FEE scholars is to find alternative languages of valuation that put the sustainability of life in a prominent position putting “life in the centre” (“la vida en el centro”) of valuation mechanisms. One of these alternative propositions is to “(re)integrate” production in its social and ecological context, encompassing all reproductive functions and conceiving all these processes as unity (Biesecker and Hofmeister, 2010). Likewise, for FEE sustainability must focus on closing the loop between production and reproduction. The key question then becomes how to rethink and reorganize the CE in a way that it incorporates care work and reproduction.

18.4 Circularity and gender Justice

This section starts by taking into account a recent study from the Industrial Development Organization of the United Nations (UNIDO 2022), which shows that women are mostly associated with “low-value added, informal and end-of- pipe activities of the circular economy”, while they form a very minority group in the “higher value-added circular activities involving greater use of advanced technologies”.

Our intention is to take this previous finding as an entry point into a broader, intersectional discussion of economic valuation mechanisms, based on a broader definition of gender justice, which aims at questioning and ultimately reframing both gender and value inequalities.

To delve into this discussion, as in the section on sustainability, we took into account the literature based on Feminist Ecological Economics. Central to this field of studies is the premise that production, intended as formal employment in the market, is only one small part of the economy, which would collapse without human, social and ecological reproduction, which largely take place outside the market, and mostly via unpaid work. This idea is represented by the diverse economies iceberg (**Figure 18.1**), which comes from feminist economic geographers J.K. Gibson Graham; The sea level, discriminating between the two parts of the iceberg, represents valuation in GDP accounting. This figure shows how GDP growth is (literally) based on the devaluation of all the work that is necessary to reproduce not only societies but also their environments.

Figure 18.1 The Diverse Economies Iceberg (Source: Community Economies Research Collective)

In addition to the dimension of sustainability, there are two other elements of analysis in FEE that allow the development of a broader definition of gender justice: care work and Social Provisioning. Care work in FEE refers to all tasks that are essential for individual wellbeing and the functioning of society, including care for nature (Martínez Álvarez and Barca, 2023). This literature focuses on how to (re)organize care work from a perspective that takes into account both social and ecological sustainability, as well as class/race and gender justice (Dengler and Lang, 2022; Hanacek, Roy, Avila and Kallis, 2020; Gottschilch and Bellina, 2017; Power, 2004). Social Provisioning in FEE refers basically to the capacity to provide for others, including the biophysical environment, through unpaid and nonmarket activities and is also the key parameter of economic valuation – rather than a marginal dimension of "the economy" – precisely because it is key to human well-being (Power, 2004). In fact, the Social Provisioning approach has driven FEE scholars towards researching wealth indicators that are alternative to GDP, i.e. capable of including both social and environmental dimensions of long-term sustainability (Berik, 2018). In the FEE literature, the elements that should appear as fundamental when measuring QoL are precisely those functions that are invisible in current value systems: the services that are provided in households, the community and nature.

Focusing on these elements that are invisible in the current value systems, coming from the mentioned contexts (households, community, nature), we find in the literature case studies referring to CE practices that fit into these premises and that are centred on alternative ways of understanding gender justice and valuation mechanisms (Van der Belden, 2021; Berry, 2022; Morrow and Davies, 2021). At the same time, as we found in some of these articles, since neither production nor consumption, are gender neutral, the implementation of a gender-just CE implies profound changes at multiple levels. Some of these authors emphasize how a proper consideration of gender issues is still missing from research on CE and how most of the systematic ways of approaching production processes from a life cycle perspective, do not contemplate gender differences, and much less a value transformation based in gender justice principles. One of the main propositions is to change the focus from value creation and reorienting CE around the ethics of care. Not considering domestic activities and care work inside households as productive or value-making leads to inadequate policies.

18.5 A value-transformative approach to CE: Reuse communities and community composting

To illuminate our approach to circularity and justice in terms of gender we will introduce two case studies based on non-corporate, i.e. community-oriented CE practices – specifically, reuse and composting – developing what we call a value-transformative approach to CE. Community-oriented CEs are described as the most fertile terrain for value transformation; however, they are also shaped by the currently dominant gender/value constructs.

Investigating community composting in New York City, Morrow and Davies (2021) highlight how the main values in reuse and repair communities are related to enhancing social cohesion as well as individual and environmental wellbeing, but most of all it is the importance of the social, material and affective relations related to care work that is done in these contexts. The authors trace the lack of consideration for social values in CE discourse 'back to the emergence of political economy as a scientific approach'. Studies of the CE in the food waste sector, they argue, tend to concentrate on technical and managerial efficiency, while overlooking aspects such as the 'labour, health, equity, care, education, and participation' involved in composting programmes (ibid) – or else, the social reproduction basis of the CE iceberg. Adopting the non-capital centric perspective of Gibson-Graham's 'diverse economies' approach, they develop an alternative framework of sustainability, based on 'a radical rethinking of economy and waste' to look beyond efficiency, privileging 'the affective, material, and ethical doing of care'. The authors define community composting as an activity based in "the notion that organic food waste is processed as closed to the sources where it was generated to capture the benefits of both the process and the finished product for the community".

In Morrow and Davies case study, transforming waste into commons facilitates collective forms of care, which contrasts market-oriented CE approaches based on revalorizing waste as commodity – i.e. as individual profit-maximization. The authors criticize mainstream CE approaches for privileging economic productivity and efficiency or commodity production and exchange, and limitless growth. As they write: "Closing loops, without attending to social impacts, equity, justice, ethics, practices, or values, will not spur the just transitions that are so urgently needed" (539). This framing marginalizes and devalues care work (the paid and unpaid labours of caring for people and the planet). This study considers four community composting sites in New York City. All of them imply a significant involvement of municipal agencies: located on public property of the city of New York, these initiatives rely on not only unwaged but also waged labour, paid for by the municipality. Nevertheless, they are all run by non-profit organizations, and work with donated waste, which they give back to the community as gifted compost, co-produced and shared with the communities who are usually at the receiving end of toxic waste from the linear economy, but also of large municipal composting infrastructures (e.g. youth from communities of colour).

By processing food waste in the places where it is produced and collected, community composting allows to bypass the spatial injustice of centralized municipal composting facilities, which inevitably end up moving large quantities of waste into poorer communities of colour. Community composting is not only about closing material loops in urban metabolism, but also about countering environmental injustice, and 'circulating resources where they are most needed, according to the logics of care, social justice, and solidarity'. The authors argue that 'In direct contrast to the commercial and municipal kerb-side collection of organic waste and the mega-facility composting infrastructures which are exacerbating socio-environmental injustices, community composting ensures the value of end-of-life food remains within the territorial communities that create it.

However, following mainstream CE discourse, municipal assessments of composting tend to focus on economic efficiency rather than care and justice. As a consequence, turning waste into a common, rather than a commodity, makes community composting's contribution to sustainability largely invisible in GDP accounting. In short, this study describes New York City community composting as an example of the unvalued and invisible caring labour that sustains the CE iceberg, but also of already existing alternative, justice-oriented ways of practicing CE.

Drawing on theories of gendered social reproductive labor, Berry (2022) investigates reuse communities, predominantly formed by volunteer women. The author proposes framing CE as an effort at closing the loop between production and reproduction by expanding our understanding of CE towards including care work, specifically that which takes place outside the household, in community-based reuse organizations. Investigating, through ethnographic fieldwork, community thrift shops in rural Maine, the article highlights the labour of managing the daily overwhelming flow of used stuff, which the author defines as 'donation dumping', i.e. a practice that frees consumers of guilt, implicitly encouraging more consumption (thus keeping production going), and, in the process, depleting the labour of reuse volunteers.

From a feminist political economy perspective, donation dumping represents the valued production that grows unsustainably over the unvalued labour of reproduction, understood here as caring for the environment by taking care of discarded objects. Berry argues that, just as it happens with reproductive work carried out within the household, community-based reuse tends to be underacknowledged and devalued compared to other kinds of labour, because of its gendered dimension. Reuse is characterized as an invisible care work because it is unpaid work mostly done by women volunteers and does not generate market value. 'If the unpaid care work volunteers perform is not seen as labour – the author argues – and the negative effects of this work on laborers are not counted among the potential harms of a linear system of production-consumption-disposal, then policies designed to address such systems will fail'.

They call for 'a need to shift burdens onto producers' through 'extended producer responsibility programs', i.e. shifting our understanding of producers' responsibility from one centred on the environment, to one centred on both the environment and labour, including unpaid labour. Nevertheless, they conclude, 'Questions about the monetary value of this gendered, voluntary labour here elide the overarching problem: there is simply too much stuff'. Thus, the emphasis would be on setting limits to growth and production rather than economically valuing this gendered volunteer work, which, as observed in the analysis of the FEE or degrowth literature, can lead to the individualization of collective problems and the commodification of social and common practices and resources. Once again the focus is on reframing economic valuation mechanisms.

The invisibility of the GS and the implications for justice

As we mentioned at the beginning of this section, these two case studies are important because they show practices that develop a value-transformative approach to CE. But both are contextualized in countries of the GN. In our literature review, we have observed how a large part of the case studies focused on this approach are contextualized in Europe or the United States (Coghlan *et al,* 2022; McQueen *et al,* 2022; Berry 2022; van der Velden, 2021; Morrow and Davies, 2021), when there are numerous examples throughout the GS (especially in Latin America) of practices with this approach and generally located in alternative and transformative economies. As Pablo Paño Yañez (2021) argues, there are already some embedded CE practices in numerous regions in the South, based on better rates of re-utilization and repair, as well as lower consumption, which equals to decrease.

Paño Yañez (2021) points out that capitalism does not manifest itself with such expansion in the habits of these territories, while the continuity of other production, exchange and consumption systems also show other practices. Urban recycling, agroecology and permaculture initiatives would be specific examples that provide livelihood to many people through popular and social economy (2021:290). As Paño Yañez (2021) puts it, it seems important to highlight the connection of these practices with deeply rooted conceptions in territories of the GS such as the conception of *Buen Vivir* in Latin America (2021), also linked to central elements in CE such as the sustainability and specifically the concept of "sustainability of life". Both, the latter and *Buen Vivir* conception deviate from a rational, productivist logic and offer alternative approaches to social justice and aspiring to live through values of reciprocity, complementarity, and relationality (Jimenez et al., 2022). For both, the main purpose is the satisfaction of direct human needs and the reproduction of life (a good life) in the widest sense. Buen Vivir, when grounded on the lived experiences of indigenous and marginalised peoples in the GS, can be understood as a *mobilising utopia* that embraces CE practices and justice (ibid).

A relevant example that Paño's article points out, which appears in the little literature focused on the GS and also in the numerous contents of gray literature, is that of waste pickers. For Paño, these are central agents linked to practices located in the orbit of CE, but which are made up of sectors of the population that are precarious and little recognized at the social and institutional level, and of course also at a salary level. These people usually work within the framework of an informal and feminized job. This article also points to the passage of waste collection for recycling at the hands of large companies as a process that led to a significant worsening of inequality in this context, eliminating a form of maintenance that was historically assumed in a decentralized manner by thousands of families that end up lacking this form of income.

The importance of waste pickers is also mentioned in an article by Gammage, Kabeer and van der Meulen Rodgers (2015) in which the question of agency is explored from the perspective of feminist economics. These authors point out the Global Alliance of Waste Pickers (GAWP) as an example of important initiatives in the GS "to raise consciousness about the role of waste pickers as important players in mitigating climate change and contributing to a sustainable development" (2015:15). GAWP also fights for promoting waste picker right to be included in urban policy development. One of the GAWP achievements has been to support claims-making by waste picker organizations and increase their influence over waste policy management, recycling programs and pricing. In fact, the Packaging Act in Uruguay in 2007 was influenced by the organizing strategies of waste pickers supported by different NGOs such as WIEGO (Women in Informal Employment Globalizing and Organizing) and GAWP (2015).

Along the same lines, but focused specifically on the implementation of the circular economy, is the article by Valencia et al (2023). This article highlights the importance of these actors (specifically female waste picker leaders from Ecuador and Colombia) and their demands for dignity, care-work counting and environmental justice when proposing a guide policy and practice for a just transition to a circular economy

Overall, it is surprising that there is a substantial lack of literature that frames gender dynamics in CE in the GS. The lack of literature, however, should not be confused with lack of real-world examples. It just demonstrates the coloniality of knowledge that is embedded in CE research (Pansera et al., 2021). We argue that there is a need to focus on these experiences if we are to develop a gender justice approach to CE, where the experiences of women in the GS are acknowledged.

18.6 Conclusions

This chapter has concentrated on dissecting how gender has been positioned within CE research and the implications of this framing for justice dimensions. Our starting point is that, rather than applying an uncritical gender lens to CE, these lenses must be framed from a gender justice perspective. Our position has been to adopt FEE given the important aspect of social division of labour which is crucial for looking at CE practices. We acknowledge that other gender approaches that are grounded in justice would also provide interesting insights into this area.

The literature review conducted for this chapter has revealed two important aspects. First, gender is not at the core of CE research, which risks invisibilising women experiences's but also, devaluing the importance of social and reproductive work. Importantly, the way in which gender is embedded in sustainability and the SDGs should serve as a cautionary tale for what occurs if our approach to gender is not framed by a logic of justice, but rather by neoliberal values that emphasise empowerment while ignoring structural inequalities.

The second aspect is that the majority of literature that examines the gender dimension of CE focuses on Northern experiences. As previously mentioned, it is essential that this disparity be viewed as a broader problem with the production of knowledge, in which the GS is largely ignored or viewed with a precarious mindset. It is not the case that there are no examples of feminist CE initiatives; however, more research is required to investigate these initiatives and determine what the GN can learn from them.

Both these aspects suggest a missed opportunity for understanding just transitions to CE. They need to be addressed if we are to truly have a gender justice lens to CE. In order to do this, the following are some recommendations:

Explicitly embrace a gender justice perspective. Otherwise, you could adopt a gender perspective that homogenises women's experiences and emphasises individual rather than structural dimensions.

Adopt a gendered innovation strategy that integrates a gender perspective throughout the research process. To avoid neoliberal framings, it is essential, however, that this be viewed through a gender justice lens.

Embrace a decolonial perspective when producing knowledge. CE experiences of women exist in the GS. It is imperative to explore what it means that these experiences are not informing our way of understanding CE.

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Chapter 19. LABOUR IN THE TRANSITION TO THE CIRCULAR ECONOMY

A CRITICAL LITERATURE REVIEW ON JUST TRANSITION AND CIRCULAR ECONOMY

Paul Guillibert, Emanuele Leonardi, Jonas Van Vossole

Abstract

The Circular Economy (CE) is an economic project based on object design, reuse, recycling and transformation that aims to limit the extraction of resources, waste and pollution to a minimum. It is a mode of production that seeks to respond to the challenges of the Anthropocene, namely global warming and the ecological crisis. Nevertheless, it is not always obvious to what extent CE practices and models take into account the social aspects of transitioning, in terms of decent wages or working conditions for a dignified and healthy life. In this chapter, we aim to show the importance of the perspective of labour to design circularity. Recent Just Transition (JT) literature, on the other hand, emphasizes how workers themselves can lead or design social transformation from a CE perspective, creating high-quality employment. This is a social justice requirement in line with both JT as demanded by workers' organisations and international trade unions, and Sustainable Development Goals (SDGs) as preached by the United Nations. On the one hand, CE could benefit from workers' knowledge about productive processes. On the other hand, a marginalisation of labourers would put CE at risk of entrenching – if not deepening – social inequalities. Thus, rethinking CE from the perspective of workers implies respecting five fundamental pillars of the JT: 1) Maintaining a high level of employment (quantitative approach); 2) Ensuring decent jobs and wages (qualitative approach); 3) Taking into account the capability of workers themselves to design CE-inspired labour processes (subjective approach); 4) Rethinking CE models from the perspective of women's informal or unpaid subsistence work (feminist approach); 5) Including to migrants, racially discriminated people and non-citizens in the composition of the workforce (decolonial approach).

Keywords: Labour, Just Transition, Circular Economy, Workers, Employment, Trade Unions.

This chapter explores the role of labour in CE literature, emphasizing how workers themselves can lead or design a viable and effective ecological transition, fulfilling social justice requirements – in line with both JT and the SDGs.

19.1 Introduction

This chapter explores the role workers play in the academic and “grey” literature on CE, with the aim of measuring the effects of a hypothetical ecological transition on labour and. Moreover, the chapter elaborates on how such CE-inspired transformation can be supported - or even led - by workers and their unions. Its goal is to expand social sciences’ contribution by offering a systematic and critical review of the literature on labour in connection to that on CE, analysing both bibliometric data and contents of a selection of particularly relevant papers. It starts from two main questions:

1. are workers’ subjectivity and trade-unions’ agency taken into account in CE models and practices?
2. If not, what would CE look like from the labour’s point of view?

To begin, it is useful to clarify our definitions of two main concepts:

Circular Economy (CE) is a regenerative system of production and consumption, closing the loop of economic cycles of inputs and outputs preserving natural resources, limiting pollution and regulating waste (Pansera, Genovese and Ripa 2021). Circular activities include sectors such as repair, reuse, and recycling.[33] Activities that aimed to reduce the use of materials, pollutant emissions, waste, and remanufacturing industrial goods are also included.

Just transition [JT] introduces the issue of social justice into the technical reflections on ecological transition and has recently become a central concept in climate discussions (Stevis 2023). Since the early 1990s, labour organisations have forged the concept to claim that an ecological transition could not happen if all its social burdens fell onto workers’ shoulders (Mazzocchi 1993). Since then, JT has been first formalized (ETUI 2011), then - in 2015 - included in the Paris Agreement. JT is nowadays one of the watchwords of many international organisations and trade unions - the so-called *Global Stocktake*, namely the concluding decision of 2023 COP 28, mentions it ten times! (UNFCCC 2023). JT seeks to overcome the fear that addressing the monumental challenge of transitiong will require us to choose between either protecting the planet or protecting workers and the economy (Ciplet and Harrison 2020; Räthzel and Uzzel, 2012). The problem is how to support the most ambitious objectives for ecological transition in a way that is at the same time ecologically *effective* and socially *fair*, which is to say attentive to workers and their communities. In its current, official definition (ILO, 2018), JT must guarantee decent working conditions for all, quality green jobs, including for workers in sectors that must be abandoned.

19.2 Different approaches to Labour

As we are specifically looking for a labour-oriented CE perspective based on JT principles, it is also useful to define what we mean by “labour”. We adopt a broad understanding that includes all forms of work, namely the whole set

[33] According to the Circular Economy Action Plan and in the Monitoring Framework for Circular Economy of the EC (European Commission 2020).

of activities which are socially coordinated to produce what is useful to satisfy human needs. This includes the practices of all waged and unwaged workers, who re/produce all that is necessary to the development of life on Earth: people, food, commodities, infrastructures, services, knowledge, art, and the biophysical environment itself. In the specialized academic literature, however, labour is typically approached in a significantly more restricted way; as waged work - jobs - in industry or service sectors. In the following paragraphs we identify and develop five different approaches we have encountered, respectively based on: quantity, quality, agency, gender, and "race".

19.2.1 A focus on quantity: Number of jobs

The most common approach to labour in the transition to CE is the quantitative one. It aims to evaluate the effects of public policies on employment and job creation within circular activities. The European Comission's New Circular Economy Action Plan is based on such a quantitative approach. Effects are measured in terms of numbers of jobs created per sector, often linked to econometric projections of GDP growth in the context of a transition to the CE. For example, it gives much emphasis to a study by Cambridge Econometrics estimating that "applying circular economy principles across the EU economy has the potential to increase EU GDP by an additional 0.5% by 2030 creating around 700.000 new jobs'' (European Commission 2020). The same plan also exemplifies how these quantitative approaches tend to measure the effects of capital composition on employment by calculating the ratio between capital intensity and labour intensity in circular activities (Llorente-González and Vence 2020). Overall, the quantitative approach can certainly be useful to understand some of the effects of labour market restructuring between different economic sectors on a global scale, but should be complemented by other perspectives, in a pluralistic effort.

19.2.2 A focus on quality: Decent work

An approach that takes into account the way in which labour is performed, rather than the sheer number of jobs, can be considered qualitative. It has a particular focus on working conditions, including their social and environmental determinants. The quality of labour is generally formulated in terms of "decent work'' or "quality jobs'' (Poschen 2017; van der Ree 2019). Decency has been defined as being "productive work for women and men in conditions of freedom, equity, security and human dignity" (UNEP 2008). Decent work is productive and delivers a fair income; it provides security in the workplace and social protection for workers and their families; it offers better prospects for personal development and encourages social integration; it gives people the freedom to express concerns, to organize and to participate in decisions that affect their lives, guaranteeing equal opportunities and treatment for all (ILO 2008).
A similar qualitative dimension is present in the recommendations of the Agenda 2030 and its Sustainable Development Goals (SDGs), which "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" (United Nations 2015). Both definitions nevertheless mix a quantitative and a qualitative approach. Both, in fact, presuppose that an increase in the number of jobs is socially desirable. Yet, it is important to keep in mind that an increasing number of jobs does not automatically guarantee their quality, nor their environmentally beneficial performance.

Labour can - and actually does - "disturb" the biosphere. It often involves the extraction of raw materials beyond the regenerative capacity of ecosystems, resulting in resource depletion or biodiversity collapse. It also usually requires an input of energy. Therefore, in a fossil economy, job creation tends to lead to an increase in greenhouse gas emissions, hence an acceleration of global warming. Finally, there is the problem of waste (Armiero 2021), which can be reduced - but never totally eliminated - while maintaining an increase in production of goods at current technology levels. This is particularly the case in the construction and clothing industries.

This raises the problem of economic growth: if an expansion of GDP presupposes a system that seeks to produce more commodities to satisfy ever-increasing human needs, then it will be accompanied by an enlargement in the disturbance of natural environments. In a situation fully inspired by CE principles, we can imagine producing as many goods as in the previous cycle, but not more, since that presupposes extracting more resources, consuming more energy and producing more waste. It is difficult to conceive of an economy that aims to limit extraction, pollution and waste by producing more goods.

The necessary increase in the number of jobs should thus be questioned. Green jobs are mainly linked to the sectors of reproductive labour - in the broad sense, including agricultural and care work - and services, while jobs linked to the production of new material goods tend to deteriorate the relations with the environment by extracting raw materials, emitting greenhouse gases or producing additional waste.

19.2.3 A focus on subjectivity: The agency of the workers

A third approach focuses on workers as a potentially active subject of a CE-inspired transition. A classic example of the input and creativity of workers in the restructuring of industry in ecological terms is the famous Lucas plan of 1976. Threatened by thousands of jobs losses, workers of Lucas Aerospace in the UK published an alternative plan for the future of their company, which involved electric bicycles, wind turbines, energy conservation services, heat-pumps, re-manufactured products (Räthzel, Uzzell and Elliot 2010).

A more recent, but equally relevant example is that of the ex-GKN occupied factory in Campi Bisenzio, near Florence. In July 2021, facing massive layoffs due to delocalisation, the workers of this automotive factory first called a permanent assembly (which is still operational) and then built an alliance with the climate justice movement (Gabbriellini and Imperatore 2023). Through the direct involvement of many solidary researchers, the Factory Collective was able to produce an innovative reconversion plan. It claims the intervention of the national Government to enable an automotive value chain no longer subordinated to car-centred private mobility, but rather oriented - in line with CE objectives - towards public and sustainable bus-centred mobility (Feltrin and Leonardi 2023).

More generally, worker's agency not only gives meaning, pride and recognition on the job, it is also important to initiate the transition to CE at different scales. At the enterprise level, workers should have a role to play in general decisions, enterprise strategies, occupational health and safety, and production processes. At the national level, workers' proposals for social and environmental measures should find expression through unions and social dialogue – no matter how difficult and problematic such perspective may prove (Keil and Kreinin 2022).

The approach of eco-design - of objects and technical systems - centred on labour (White 2020; Valencia, Koppelmäki, Morrow et al. 2020) seem to us particularly useful in the transition to a circular economy. It combines the concept of workplace design - born in the 1970s in the Scandinavian trade unions, aimed at implementing workers-friendly modes of design and innovation, with eco-design. Eco-design (Ceschin and Gaziulusoy 2020) refers to the design for reuse, reemployment and recycling but should also take into account the type of labour process involved and the relationship to the environment in workplaces. A workers-based view should also include all actors involved in determining the function of an object or a technical system. Domestic workers or workers in the reuse or recycling sectors have an important role - often invisible - in the use of objects: informal waste-pickers know best the different transformations an object can undergo (Archer and Adelina 2021). Such participatory workers' design strategies require new forms of industrial eco-democracy, to be achieved through social dialogue via trade unions, cooperative enterprises or direct and participatory democracy (White 2021).

19.2.4 A focus on gender: The eco-feminist perspective on labour

Income from paid labour is not the only material resource for well-being and dignity (Barca 2019; Barca 2020; Gibson 2020). Unpaid labour, as an important part of social and environmental reproduction, can play a key role in the development of a circular society. Taking care of living beings, be them children or parents, cooking, sorting waste: all these are activities that ensure the reproduction of society within the domestic sphere. A gendered approach to labour focuses on these invisiblized spheres to rethink work as a whole. It uncovers a huge amount of unpaid labour, mostly done by women and/or racialized people (Dombroski 2020). Examples are: care work for people or the natural environment, domestic labour and reproductive work more generally, to ensure the subsistence conditions of communities. Many circular activities, such as volunteering in recycling centres, are carried out by unpaid workers. Some authors therefore propose to shift the focus from paid labour and consumption to unpaid care work for other humans and environments (Gibson-Graham, Cameron and Healy 2013). Questioning the sexual division of labour inherited from early modernity (Salleh 2004) allows for a critique of gender inequalities in income, hygiene, health and safety at work. It also allows us to envisage a low-carbon economy that aims at the wellbeing of human and non-human communities instead of devaluing unpaid reproductive tasks and overvaluing paid productive activities. Waste sorting – or environmental domestic labour (Farbotko 2017) - is often free labour, mostly performed by women. Reuse, remanufacturing and recycling rely both on ecological conditions that need to be maintained and on domestic tasks without which products cannot be reintroduced into CE (Battistoni 2020; Ravenswood 2022). Domestic labour should thus be at the heart of reflections concerning CE.

19.2.5 A focus on "race": The postcolonial critique

Postcolonial approaches to labour (Chakrabarty 2007; Mezzadra 2011) show how the Eurocentric focus on the white male wage-earner obscures the history of a whole section of male and female workers (Spivak 2015). Post-colonial theories focus on non-manufacturing activities outside the Northern metropolitan centres. At the epistemological and political level, post-colonial approaches to labour give voice to those who do not have. Furthermore, they take into account types of work that were often disregarded by modernist theories, which often focus on productive labour, namely: the activity of transforming natural matter by natural human agency, in order to satisfy specific social needs. Such definition of labour excludes care and reproduction activities, agricultural eco-regulation work and most of the service sector, particularly in the informal economy. Moreover, it neglects illegal workers, especially women (Farris 2020) and the international division of labour which devotes certain areas of the world economy entirely to certain forms of labour (Mies 1982, van der Linden 2008).

This, with regard to this literature, two important issues emerge: the place for racially discriminated, immigrant and non-citizen workers; and the international division of labour required by a CE-inspired transformation. Although such issues are very rarely addressed, a transition that truly leaves no one behind - starting with people in migratory situations, people of colour in Northern countries, and frontline communities in Southern countries - should not ignore them.

19.3 A systematic literature review

In order to better analyse the intersecting literature on CE and JT, and to be able to develop new theoretical perspectives, we enriched our critical literature review with bibliometric and content analysis of the collected papers (Grant and Booth, 2009). We followed the methodology used in Circular economy and social inclusion: a systematic literature review by Oliveira, Vincenzi and Souza Piao (2021). Our critical bibliography consisted of 232 academic papers and reports from international organisations, NGOs or trade unions; most of them were published after 2015.[34]

19.3.1 CE in the academic literature

There is a generalized lack of interest in labour issues within the academic literature on CE. Out of 14,825 references on "Circular Economy" in Web of Science, only 73 mention "Labour" (most of which are actually irrelevant). This already uncovers a way of thinking about CE that focuses on economic and ecological flows without taking into account working conditions and workers' agency. In the few cases the literature mentions labour, it is mainly through quantitative approaches, although there is also an increasing consideration of its qualitative dimension.

As job creation is one of the assumed objectives of the conventional CE (Stahel 2016), it is unsurprising that it forms the focus of about one third of the academic literature; sometimes as the sole social indicator (Mies and Gold 2021). The literature seems to show an overall, albeit minimal net increase of jobs (Mitchell and James, 2015; Wijkman and Skånberg, 2015; Larsson and Lindfred 2019; Wiebe et al., 2019)[35]. The results of an overall increase in employment have however been criticized.

The results of these calculations are often uncertain, due to the complexity of concrete situations or because of the diversity of economic models. It is difficult to calculate the number of jobs of an hypothetical policy without considering monetary and fiscal regimes, and to measure indirect effects on employment in sectors that are not directly affected by the transition. Moreover, most studies are based on ex-ante macro-economic models. There are very few ex-post studies of actual CE-inspired transitions.

[34] Further details on our methodology can be found in Guillibert, Barca and Leonardi (2022).

[35] The assessments of the overall increase in employment are more positive in reports from public and private organisations than the academic literature on the subject (Stavropoulos and Burger 2020).

Moreover, what is needed is an international, global approach - as regional or national borders do not correspond to real material flows in a global value chain economy (Geng, Sarkis, Bleischwitz 2019). The academic literature is nevertheless very little concerned with the international division of labour or with global capitalism. Less than 0.4% of papers on CE mentions “International" in their title or abstract; even less mentions “Global value chain'' or “International trade''. Studies on global value chains - for example in the textile industry - have nevertheless shown that transition to CE in the GN may be accompanied by a decrease of jobs in the production countries (Repp, Hekkert, Kirchherr, 2021), reinforcing social and spatial inequalities (Schroeder, Dewick, Kusi-Sarpong, Hofstetter, 2018).

Finally, we believe important consideration should be accorded to working conditions - wages, length and intensity of the working day, type and duration of contracts, access to social security and union representation, decent and equal treatment of workers. Academic literature on CE generally takes little account of the variation in the amount and type of employment created in different sectors. A rare exception is the study of Llorente-González and Vence (2020), which compares capital-intensive - such as recycling and waste recovery - and labour-intensive sectors - like remanufacturing and repair - to show that not all sectors of CE produce the same number or quality of jobs. Capital-intensive sectors appear to be creating more well-paid jobs, but in smaller numbers. Conversely, the labour-intensive sectors create more jobs, but those more precarious, with lower wages and a higher rate of unpaid labour.

In this context, JT has gained increasing attention since the Paris Agreement in 2015 and the ILO's 2018 report. In parallel, the idea of “green jobs” has become popular as a means of balancing economic growth with environmental and social concerns (Sulich and Soloducho-Pelc 2022). The formula green jobs differs from decent and quality jobs insofar as the former seeks to reconcile ecological transition and economic growth and rarely challenges the organisation of labour, while the latter involves a reflection on the decision-making power within the company and tends to focus on working conditions, wages, the length and intensity of the working day, social protection, and the presence of trade union representation. The challenge for a fair and sustainable decision-making system is both to give workers a central place in the company's management and to integrate environmental standards.

With very rare exceptions (Buch et al. 2021), academic papers disregard the agency of workers, the effects of the transition on reproductive and unpaid labour or the potential role of non-citizen immigrant workers in CE. Workers are generally depicted as passive, in contrast to organisations - which are deemed active.

19.3.2 Labour in institutional reports

In our analysis of the interconnections between CE and labour issues within institutional reports, we distinguish three types of institutions: trade unions, public organisations (national, regional and international), and the third sector (NGOs, private foundations, think-tanks, activist groups). While in most countries trade unions are governed by private law and are legally assimilated to private non-profit organisations, they represent the voice of workers, so we dedicate a separate section to them.

19.3.3 Trade Unions and CE

Trade Unions generally do not seem interested in CE. At best, some trade-union reports mention it in passing or devote a scarce paragraph to it. Local and national unions hardly ever talk about the concept. Even the International Trade Union Confederation (ITUC) - most dedicated to JT - has never devoted a full report to CE. ITUC only notes that JT does not involve a phase-out but rather a transformation of certain sectors, implying the need for massive skills training for workers.

The transition to the CE thus is not a demand from workers themselves, although some international confederations of unions are beginning to understand it as an opportunity for employment and social dialogue (Gough 2022). It might be that CE is perceived as detrimental to workers' interests as too top-down, business-oriented, academic, or technocratic - ultimately inadequate to express the views and interests of workers and their representatives. Further empirical research is needed, however, to discover the reasons for such indifference towards CE, or even rejection of it.

In the few occasion trade unions mention CE, their reports mention the focus on quantitative aspects of labour but rapidly move on to include qualitative aspects, such as working conditions, decent jobs, fair wages and the length of the working day. For example, in Waste management in Europe. Good Jobs in the circular economy? the European Public Service Union criticizes that employment conditions are severely under-researched. Regarding the first EU package on CE (European Commission 2022) - which proposes to make almost all physical goods on the EU market more environmentally-friendly, circular, and energy-efficient throughout their whole lifecycle -, the ETUC welcomes the opportunity "to fight climate change, reduce our environmental impact and create new jobs", but criticizes the "missed opportunity to integrate a just transition into a much-needed climate policy". The EU, it is claimed, allegedly focuses on job opportunities - concentrated in sectors of waste management and repair - without mentioning the job losses in extractive or manufacturing sectors. It insufficiently considers the need for workers' retraining, and neglects working conditions and sufficient trade-union representation. Trade unions' reports tend to establish the link between ecological change and social justice both in terms of supporting workers in the transition and of limiting inequalities that may emerge from it. Trade unions are especially concerned with labour conditions, health and safety at work and economic, racial and gender inequalities. This is particularly the case in the waste management sector, where exposure to certain materials represents specific health risks.

Until very recently, CE was not seen as an overall transformation of the economy and society (EPSU 2017, ITUC 2017) in trade unions' literature, but rather framed in terms of waste reduction and the possibility of recycling. For example, the Campaign Against Climate Change - Trade Union Group in the United Kingdom (CACCTU 2021) sees an important opportunity for developing decent, well-paid and well-protected jobs, but the chapter on CE in their report - Building a workforce for climate emergency - is in fact, solely dedicated to the waste sector.

However, a more thorough understanding of CE is recently emerging. The latest report of the European Social Partners' Project on Circular economy and the world of work (Cihlarova, Forestier and Zibell 2021) marks an important turning point. Here, CE is both understood as a general transformation of production and consumption, and as a political lever for workers. Like other studies (Laubinger et al. 2020), it assumes a limited but positive overall impact on employment volumes (0 to 2%), differentiated among economic sectors. The report stresses the requirement of higher skills for workers - who, managing a more irregular input off recycled materials, need to be more flexible, needing "Works Councils and Health and Safety Committees" to collect information and develop concrete measures to move towards circular business models. It is also concerned about the level of social dialogue and precariousness in CE (especially regarding informal work).

19.3.4 What do International Public Institutions say?

Being largely developed by economists in public institutions, the literature on the CE from those institutions is huge. Basically, all reports do mention the issue of labour. We therefore mainly dealt with those where the issue of labour appears as central, or those in which it assumes a remarkable position - either because it was a commonly shared position; or because it stood out from the rest; or else because it was released by a particularly important institution (e.g. the European Commission or ILO).

Public institutional reports mostly assume a quantitative approach to labour. All the reports on how to implement the first Circular Economy Action Plan (2015) talked about job creation, but scarcely addressed the quality of the jobs and the working conditions. In each of the few mentions of employment in the EC's report to Parliament (European Commission 2019), only a net increase in employment is mentioned, ignoring working conditions, social dialogue or decision-making opportunities. Similarly, another report (Cambridge Econometrics, European Commission et al. 2018), titled Impacts of circular economy policies on the labour market, develops a quantitative-only approach to labour issues. The latest publication of the Green Deal (European Commission 2022) emphasizes "empowering the consumer", while employment and JT are barely mentioned. In a new Eco-design for Sustainable Products Regulation[36], the only reference to labour concerns the number of jobs created, without even acknowledging conditions and longevity, not to mention opportunities for workers-led design.

The public institution which is most attentive to working conditions and the development of decent work is the International Labour Organisation (ILO). Their 2022 report takes into consideration the effects of CE at a global scale, but also the number of quality and decent jobs that have been created by attempts at CE transitions in different countries. As for the former, the employment effects of industrial symbiosis are positive, in particular if the impacts are taken into account along an entire value chain. The quality of the jobs created, however, is not guaranteed. Some decent work deficits exist where industrial symbiosis schemes are in place.

In some countries, circular activities related to reuse, repairing or re-cycling are largely carried out by informal workers. If informal workers are defined as those who have no pension insurance, the ILO considers that the share of informal labour can be as high as 90%.

While still underdeveloped, some public institutions' reports on labour and CE do consider gender disparities, women's labour, reproductive and unpaid work (Laubinger, Lanzi, Château 2020). A feminist approach to work is still, however, extremely rare. In its 2019 report Skills for a greener future, the ILO was the first public institution to evaluate the possible effects of a global transition to CE on the gendered division of labour (ILO 2019). It concluded that, as new jobs are dependent on appropriate training, and since women tend to receive less training in new technologies, women are likely to benefit less than men from such possible transition. Without appropriate training policies, a global transition to CE could increase social inequalities between men and women and between skilled and precarious workers. Unless measures are taken to train women in relevant skills, current occupational gender stereotypes are likely to persist and women will get only a small fraction of the jobs created (ILO 2019).

Other dimensions of labour - such as workers' agency in the reorganisation of production and corporate decisions, the effects on domestic and reproductive work, the place of racially discriminated or non-citizen workers - are still completely absent from institutional reports on the transition to circular activities.

19.3.5 Labour according to the "Third sector"

[36] https://environment.ec.europa.eu/publications/proposal-ecodesign-sustainable-products-regulation_en

Reports issued from third sector - actors such as NGOs, private foundations, activist groups - have a wide variety of political and ideological positions. The variety is much larger than in trade-unions' and public institutions' reports. This can be explained by their different nature and funding. The 2018 UN Research Institute for Social Development distinguishes four political approaches to the JT: Status quo approaches which propose the greening of capitalism through voluntary, bottom-up corporate and market-driven changes; Managerial reform approaches which seek greater equity and justice within the existing economic system through modification of certain rules and standards of employment, safety and health; Structural reform approaches in which both distributive justice and equitable decision-making processes by the different stakeholders guide the transition; Transformative approaches which imply an overhaul of the existing economic and political system built on continuous growth and imply profoundly different human-environment relations (Morena, Krause and Stevis 2019).
Most reports we discussed before - from trade unions and public institutions - can be classified in the first two categories. The reports from third sector actors, on the other hand, are distributed among all four positions. Reports by the Ellen McArthur Foundation and McKinsey (2015), or the Green Alliance in the United Kingdom (Coats and Benton 2015) have, for example, strictly quantitative visions of labour, and are therefore Status quo approaches. Reports from Chatham House (Schroeder, Albaladejo, Ribas, MacEwen and Tilkanen 2020) and the International Institute for Sustainable Development (Echeverria, Roth, Mostafa and Gass 2020), with their focus on social and geographical effects of the inclusion of countries in the GS, can be classified within the Managerial reform approach. The Circular Jobs Initiative (Goodwin, Schröder, Bachus and Bozkurt 2020), which is attentive to democracy at work, takes a Structural reform approach. The Stockholm Environment Institute (2019; Atteridge and Strambo 2020; Aung and Boyland 2020), exemplifies the Transformative approach insofar as it testifies a desire to change power relations by re-establishing workers' power over their working conditions.
Many third sector reports tend to emphasize the positive effects - and, conversely, to downplay the negative effects - of a transition to CE. For example, the report by the International Institute for Sustainable Development notes that: "All measures present positive net benefits in job creation (direct and indirect) and induced economic impacts. However, [... some] more as enablers than direct job creators'' (Echeverría, Roth, Mostafa and Gass 2020, 21). Another report suggests that "the circular economy could create 200,000–500,000 gross jobs, reduce unemployment by 50,000–100,000, and offset 7–22 percent of the expected decline in skilled employment by 2022'' (Ellen MacArthur Foundation and McKinsey 2015, 34).
However, macro-economic models are much more contradictory. In most studies, it is difficult to measure indirect employment effects in sectors that are not directly affected by the transition to CE (Laubinger, Lanzi, Chateau 2020). Third-sector reports tend to favour the results of certain scientific studies, which are more consistent with their own public strategies, rather than reporting on the complexity of calculations. Third-sector reports also favour ex-ante macroeconomic studies over geographically situated case studies in specific sectors. This methodological difference leads to a low degree of testing of the models against the reality on the ground of economic actors in a globalized economy.
Many reports from third-sector organisations take seriously gender and racial inequalities, discrimination and the social inclusion of precarious workers. NGOs' literature makes strong links to social economy and informal sectors. Some reports assume that participatory organizations are more inclusive, emphasizing the importance of workers' cooperatives for JT (Goodwin, Schröder, Bachus and Bozkurt 2020; Mugambi, Windberg, Ddiba, Ogol, Andersson, Gicheru and Akinyi 2020; Miguel, Martinez, Pereira and Kohout 2021). Many reports focus also on gender

inequalities and how a transition to CE can either limit or accentuate them (Johnson, Han, Knight, Mortensen, Aung, Boyland and Resurrección 2020).

Finally, as a concrete example, we focus on a report by Diane Archer and Charlotte Adelina (2021), from the Stockholm Environmental Institute, in which all of the five approaches to labour we have discussed are represented:

"Waste pickers in Bangkok make significant contributions to the reduction of plastic waste leakages and, therefore, play a key role in advancing a 'circular economy' at the urban level. However, most of them are living below minimum wage conditions and face other threats to their livelihoods, such as a lack of access to market information, occupational health hazards, societal discrimination and harassment, and a lack of organisation and social security protections. Even within this group, some workers may be more vulnerable than others – such as street waste pickers (as opposed to salengs who buy waste from customers); waste pickers who work and live near landfills or dumpsites; women with physical safety concerns when they access public spaces and with lower asset ownership; the elderly, children, and migrant workers".

We consider this inclusiveness as a good starting point for defining an area of intersection between CE and JT: one that aims at dignified and decent work for all, where workers can decide the direction of their labour and participate in the design of the tools of production, in a way that tackles gender and racial inequalities.

19.6 Conclusions

Our definition of labour, combining five different approaches, allowed us to identify which dimensions of labour are already present in the studies on CE – as well as those which are completely absent. Quantitative approaches are very often used, qualitative approaches a little less. The approaches focused on workers' decision-making power and agency, gender inequalities and racism in the labour market, are very rare. Our research confirms the claim (Kirchherr, 2021) that only very few works on CE focus on the social justice and equality.

Under these conditions, transition to CE not only risks maintaining social, gender and racial inequalities, but also accentuating them. A transition is likely to privilege white men with average skills over women and other sections of the population. We observed a nearly complete lack of consideration of racial issues. The very small number of global and international CE models - most are national or regional - does not allow to measure North-South inequalities. There is generally a lack of reflection on labour conditions - particularly in terms of contracts - which leaves out informal, often racialized, workers in the North.

We acknowledge that the main limitation of our research has been its reliance on secondary sources: for example, workers' actual voices are not directly represented in this chapter. Paradoxically, this bias particularly affects informal workers (most of them women and racialized workers) who are directly involved with hands-on waste and recycling work, while being unrepresented by trade unions, public institutions and/or third-sector organisations. Yet, we maintain that our effort can foster a JT-based conceptualisation of CE literature by opening up a workers-friendly space for scientific reflection.

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Chapter 20. Circular Economy (CE) in African countries

Cephas Mandizvidza and Raymond Makhanda

Abstract

This article shall highlight the state of CE practices in African countries and more specifically their Technology Readiness Levels (TRL). The challenges of rapid economic growth due to advancements in innovation, has seen the emergence surging of CE as a prominent concept in sustainable science. The World Business Council for Sustainable Development (WBSD) in 2020 argues that, despite the increasing awareness of a need for a more CE, our world is only 8.6% circular; with this number notably below 9.1% in 2018. In Africa circularity is still very low and most of the times CE practices are responding to the developments of CE models in the Northern world because in most situations waste (mostly toxic) is dumped in the GS (GS) from the GN (GN) as second-hand goods sold at a cheaper price. These are dumped after a short period of time, and resulting into waste management challenges: for example used cars in Africa from Europe and Asia. CE practices in Africa need to be known by the world together with their TRLs for a holistic just transition to a CE in the world.

Keywords: Circular economy, Sustainability, Environmental justice, Greenwashing

CE practices in most African countries are not known to the world. Despite the strong move towards circularity in some countries, the legacy of environmental injustice is still prevalent in and around CE practices, especially in Africa.

20.1 INTRODUCTION

Africa is a continent that is rich in natural resources, yet it remains one of the poorest continent in the world (Agouza & Abu Zaid, 2021). This is largely due to a linear economy that focuses on the extraction, production, consumption, and disposal of goods and services. The linear economy has led to environmental degradation, resource depletion, and social inequality. According to Didenko et al., 2018, the Circular Economy (CE) is an alternative economic model that can help Africa transition to a more sustainable future. The concept of CE is gaining traction globally as a sustainable model for development that seeks to minimize the use of natural

resources and reduce waste (resources efficiency). CE has the potential to create a sustainable and prosperous future for both developed and developing economies (Ghufran et al., 2022; Ogunmakinde et al., 2022).
CE aims to keep materials in use for as long as possible, minimize waste, and reduce environmental impact. In recent years, many countries have started adopting CE initiatives, and Africa is no exception. In Africa, CE presents a unique opportunity to promote economic growth and create jobs while addressing environmental and social challenges (Wait, 2022). CE principles may also potentially play a strategic role in advancing the African agenda of food security and industrialisation and improving standards of living (Ghufran et al., 2022). However, the implementation of CE practices in Africa face several challenges (Andriamahefazafy & Failler, 2022). This section will provide a comprehensive overview of CE in Africa; including the examination of the current state of CE in Africa, the challenges and opportunities, potential benefits, and the role of stakeholders in promoting its adoption. The inception of CE initiatives in Africa, focusing on the drivers, challenges, and opportunities that exist within the continent will also be explored. Some successful case studies of CE projects in Africa will be highlighted as well as recommendations for the future implementation of CE practices in the region.

20.2 BACKGROUND OF CE IN AFRICA

CE is gaining traction worldwide as a promising approach to sustainable development. The concept of CE is based on designing waste out of the system, keeping materials and resources in use, and regenerating natural systems. In Africa, CE initiatives are emerging as a way to address the region's challenges of poverty, inequality, and environmental degradation.
Africa faces significant environmental challenges due to rapid urbanization, industrialization, and population growth. According to the World Bank (2020), only 34% of waste generated in sub-Saharan Africa is collected, and less than 10% is recycled. This situation poses serious health hazards for people living in poverty, who often live in close proximity to waste dumps and landfills. Additionally, Africa has rich natural resources that are underutilized and often wasted because of inefficiencies in the manufacturing processes, leading to economic losses and environmental degradation.
To address these challenges, African countries are increasingly adopting CE approaches. For example, South Africa launched a National Waste Management Strategy (NWMS) in 2014, which aims to promote a CE by reducing waste generation, increasing recycling, and promoting responsible consumption and production (Department of Environment, Forestry and Fisheries, 2019). Ghana has also developed a national policy framework on CE principles, which seeks to promote resource efficiency, innovation, and job creation (UNEP, 2020). In addition, various private sector actors in Africa are implementing CE initiatives. For instance, Ecobank in 2021, a pan-African bank - launched a Green Small and Medium-sized Enterprises (SME) Financing Scheme, which provides financing and technical assistance to SMEs engaged in green projects, including those that promote the CE. Similarly, Coca-Cola Beverages Africa (2021) has committed to collecting and recycling 100% of its packaging by 2030 through its "World without Waste" initiative.
CE initiatives in Africa have the potential to create numerous benefits, including job creation, increased resource efficiency, reduced pollution, and improved health outcomes. However, significant challenges remain, including inadequate infrastructure, limited access to financing, and a lack of awareness and understanding of CE principles.
CE initiatives are gaining momentum in Africa as a promising approach to address the region's environmental and economic challenges. While progress has been made, much work remains to be done to scale up CE initiatives and

realize their full potential. With concerted efforts from governments, private sector actors, and civil society organizations (CSOs), CE initiatives can become a key driver of sustainable development in Africa.

Africa has had observations of sustainable economic activities that can be classified as CE and most of them were mainly driven by economic constraints (Dunmade, 2018). The CE activities were encapsulated within the topics of climate change adaptation or sustainable development (Rademaekers et al., 2020). For a while, Africa operated without absolute policies for CE, it was only when the most CE active nations, Nigeria, Rwanda and South Africa in 2017 pushed for a clear agenda on CE that led to the formation of African Circular Economy Alliance – ACEA (Dunmade, 2018 and Rademaekers et al., 2020). ACEA was financially supported by those three nations as well as the World Economic Forum (WEF) and the Global Environment Facility (GEF). The mandate for ACEA at the time was to foster a commitment to retain resources in circulation for as long as practicable. ACEA was an effort to convert concepts into accomplishments with the co-operations among governments, businesses and organizations taking the centre stage to accelerate the circular economy agenda in Africa (Bukhari et al., 2018).

Several organizations have however emerged to promote CE practices in Africa. The African Circular Economy Network (ACEN), for example, was established in 2015 to support the development of CE in Africa through research, advocacy, and collaboration (http://africancirculareconomy.org/about/). The Ellen MacArthur Foundation (EMF) has also launched initiatives in Africa, such as the CE in Cities program, which aims to develop circular economies in cities around the world, including Nairobi, Kenya (Ellen Macarthur Foundation -EMF, 2021). The formation of ACEA (that focuses on development of national and local government policies) and the ACEN (that promotes strategic application in business) is expected to increase CE activities in Africa (Desmond & Asamba, 2019). The key step towards CE for Africa was during the 17th African Ministerial Conference on the Environment (AMCEN) in 2019 that advocated for a CE action plan. An evaluation showed that by 2020, the 52 African countries have developed intentional policies that address CE components. A database by Chatham house in 2021 showed 191 CE policies for 52 African countries grouped under five broad categories as shown in **Table 20.1** and **Figure 20.1** (EMF, 2021).

Table 20.4: Description of CE related policy categories in African countries

Policy category	**Description of policy and number of African countries implementing the policy**
1.	**National CE policies** include any national CE policies already in place as well as national green growth or sustainable development strategies that integrate CE principles – 7 countries.
2.	**Product policies** are any policies that support circular practices relating to the design, manufacture, distribution or import of specific products and materials (mostly bans on plastics use or levies) – 32 countries.
3.	**EPR policies** place the responsibility for the environmental impacts of products throughout the product life cycle on producers and is often applied to the collection, processing and reuse of waste – 15 countries.
4.	**Waste management and recycling policies** encourage circular practices relating to the management of waste covering generation, segregation, transfer, sorting, treatment, recovery and disposal – 48 countries.
5	**Fiscal policies** include government tax and spending policies that incentivize circular practices – 12 countries.

Source :Ellen Macarthur Foundation, 2021

The world over, almost every country at least has a CE related policy as shown on the online world map (https://circulareconomy.earth) by the Chatham House Royal Institute of International Affairs, 2020 as referenced by the Ellen Macarthur Foundation (2021). On the African continent, the number of countries implementing policies under a certain category shows the importance of the category for African countries. According to Figure 1, the focus on waste management and recycling policies by African nations reflects a common challenge in waste management amongst the African Nations. Product policies also present a common issue on the locally produced goods as well as imported goods, which later cause waste management challenges in terms of waste especially their packaging.

Figure 20. 1 Types of existing CE policies in Africa per country by 2021. Source : Ellen Macarthur Foundation, 2021

In Africa, CE initiatives have been gaining traction in recent years, with several countries implementing policies and programs aimed at transitioning towards a more CE. Historically, many African communities have practiced CE principles for centuries. For example, in rural areas, people often make use of natural resources in a circular manner by reusing waste materials and recycling products. However, as urbanization has increased in Africa, so has the consumption of resources and waste production, leading to a need for more formalized CE initiatives.

The CE has emerged as a crucial strategy for sustainable development in Africa. While many African communities already practice circular principles, there is a growing need for more formalized policies and programs to promote circular practices on a broader scale. As initiatives such as the ACEN and EMF continue to promote the CE in Africa, it is likely that further growth of circular initiatives on the continent in the coming years will be realised.

20.2.1 CE categories, strategies and initiatives in Africa

The journey of CE in Africa though in its infancy, is built on the same principles that direct the categorisation of CE activities, which revolve around "Optimal use, Value recovery, and Circular design models" (Dunmade, 2018; Achterberg et al., 2021). Based on the European system there are 14 categories of CE of which Africa in its various efforts to achieve Sustainable Development Goals (SDGs) is implementing, listed hereafter (Hirsch and Schempp, 2020) – Table 2.

Table 20.2: CE models adopted in Africa

Type of CE model	Leverage of the model(s)
Circular design and production models	1. Focus is on the designing and production of goods that facilitate CE strategies, such as the use of recyclable or compostable materials 2. Generation and installation of process technologies that enable CE approaches 3. Development and sustainable production of novel materials (together with bio-based resources) that are reusable, recyclable, or biodegradable 4. Significantly decreasing or replacing substances of apprehension in materials and products to facilitate circularity strategies 5. A changeover from virgin resources to secondary raw materials and by-products
Circular use models	6. Approaches that promote the 9Rs of waste management for end-of-life or obsolete products and their components preventing their dumping 7. The refurbishment and repurposing of end-of design life or terminated fixed structures that includes buildings/infrastructure/facilities. 8. Ideas that are hinged on service provision , reuse, and sharing models centred on hiring pay as you go, subscription or deposit return arrangements, that allow CE approaches. 9. The rehabilitation and remediation of degraded or abandoned or underutilised brownfield sites to functional state or in preparation for revamping
Circular value recovery models	10. Waste separation and collection, and arrangements that allow for circularity of redundant products, parts and materials 11. Aim is to recover materials from waste in an attempt to retain circular value with the exclusion of biomass related materials 12. The retrieval and valorisation of biomass waste and residues, and conversion to food, feed, nutrients, bio- fertilisers, and other bio based materials or chemical feedstock 13. Wastewater reuse or recycling
Circular support	14. Creation of a platform that fosters the development/deployment of tools, applications, and services of CE strategies

Source : Hirsch and Schempp, 2020

In recent years, African governments and organizations have started to implement policies and programs aimed at promoting CE practices. The inception of CE initiatives in Africa can be traced back to the early 2000s when some African countries began to promote and implement green economic policies. Since then, several CE initiatives have emerged across the continent. Several case studies illustrate successful CE initiatives in Africa and some of them are shown in Table 3 as documented by Patterson et al., 2021 in a publication called "Circular Economy on the African Continent : Perspectives and potential".

Table 20.3 Selected CE initiatives in some African countries

Country	**Initiative(s) and descriptions**
Cameroon	The Eco bricks project involves filling plastic bottles with non-biodegradable waste to create building materials (UNEP, 2020).
Egypt	Responding to the impact of the COVID-19 pandemic, the European Bank for Reconstruction and Development (EBRD), the European Union and the Green Climate Fund are working with local partner banks to offer $264 million to businesses for green investments in energy, water and resource efficient solutions. These initiatives are aligned with existing policies, for example, the National Action Plan for Sustainable Consumption and Production, supporting Egypt's development efforts in circularity and sustainability in multiple sectors including energy, agriculture, water and waste (*Patterson et al., 2021).*
Ethiopia	The Shoe Project involves the collection of discarded shoes and refurbishes them for resale, reducing waste and creating jobs.
Ghana	An e-waste recycling company called Blue Ocean Investments (https://www.blueoceaninvestmentgh.com/) is working to reduce the impact of e-waste on the environment while creating jobs and generating income. The company processes electronic waste into usable materials such as copper, aluminium, and plastics.

Country	Initiative(s) and descriptions
Kenya	The country has implemented policies aimed at reducing waste, such as a ban on plastic bags in 2017 (Standard Digital, 2017).
Nigeria	Lagos State Waste Management Authority (LAWMA) set up a program to collect and recycle electronic waste. The "Waste to Wealth" project promotes waste recovery and recycling by creating jobs and reducing the volume of waste sent to landfills (Ellen Macarthur Foundation (EMF), 2021)
Republic of South Africa	The National Waste Management Strategy (NWMS) by Republic of South Africa includes a goal of achieving zero waste to landfill by 2022. The country also established a textile recycling facility to recycle used clothes and textiles into new products.
	The "Green Cape" program supports small and medium-sized enterprises (SMEs) in adopting CE practices through technical assistance, training, and networking opportunities (Green Cape, 2020).
Rwanda	Rwandan policies such as the Organic Law on Environmental Protection, Conservation & Management No. 04/2005, the National Environment and Climate Change Policy of 2019 and the Law No. 17/2019 explicitly promote CE to: advance sustainable consumption and production patterns, establish the correct procedures for disposal of solid, liquid, hazardous, toxic and electronic waste, prohibit the manufacturing, importation, use and sale of plastic carry bags and single-use plastic in the country. The government has implemented an ambitious CE strategy that includes banning single-use plastics, promoting composting, and building a green industrial park. The strategy has helped to reduce plastic pollution, create new jobs, and support sustainable economic growth (*Patterson et al., 2021).*
	A company called BBOXX (https://www.bboxx.com/) has developed a solar-powered battery system that allows rural residents to access electricity without relying on fossil fuels. The company also offers a pay-as-you-go model that makes it easier for low-income families to afford the technology.
Senegal	Via the Plastics Prohibition Law No. 2020-04 (EPR on plastics producers) and the Environment Code 2001 Law No. 2001-01 (ensuring the appropriate recycling and disposal of all types of waste), and Article R30 (conditions for reuse of water), the country has implemented a diverse and large number of CE initiatives particularly in agriculture and waste management (*Patterson et al., 2021).*
Zambia	LUSAKA, 3rd December 2018 – ISSUANCE OF STATUTORY INSTRUMENT NO. 65 ON EXTENDED PRODUCER RESPONSIBILITY (EPR) REGULATIONS • The Government of the Republic of Zambia through the Zambia Environmental Management Agency (ZEMA) under the Ministry of Water Development Sanitation and Environmental Protection wishes to inform the nation and the general public that the Environmental Management (EPR) Regulations, Statutory Instrument No. 65 of 2018 (EPR Regulations) came into force on 3rd August, 2018. • The Ministry wishes to inform all stakeholders that in accordance with Section 58 of the Environmental Management Act No. 12 of 2011, the EPR Regulations extends the responsibility of the producer of a product or class of products to the post-consumer stage of the product or class of products. • EPR Regulations is one of the tools that the Government will rely on to manage, in an environmentally sound manner, packaging materials such as plastics and their resultant waste. The EPR Regulations will also regulate non-returnable glass and plastic bottles, cartons, beverage cans, waste oils, pesticides or chemical containers, used tyres, electrical and electronic equipment and their resultant waste. (Forms et al., 2019)

Country	Initiative(s) and descriptions
Zimbabwe	Petrecozim (Pvt) Limited is an initiative that was started by major companies within the beverage and allied industries to address environmental pollution related to Post-Consumer Poly-Ethylene Terephthalate (PCPET) bottles. This was in line with concerns that were flagged by the Environmental Management Agency (EMA) in Zimbabwe. The disposal of PCPET bottles had become a huge problem in the country due to lack of any visible recovery and recycling effort. Various environmental stakeholders including EMA, prompted beverage companies to take the initiative at their expense to address the problem in a visible and significant way, therefore raised serious concerns. These companies use Poly-Ethylene Terephthalate (PET) packaging in their operations in one way or another as converters, bottlers or brand owners and therefore felt a compelling need to participate to fulfil their Extended Producer Responsibility (EPR) obligations.
	A case of industrial Symbiosis (IS) has been witnessed from a by-product of phosphatic fertilizers manufacturing. Zimphos is the country's sole producer of phosphate fertilizers, aluminium sulphate for municipal water treatment, sulphuric acid and other industrial chemicals. Gypsum is the main by-product of the manufacturing processes. The by-product, which is a waste, has been found to be useful in various productive sectors of the world. A company has been formed and capitalising on the use of gypsum to make ceiling boards, plastering materials, paints, grout and ceiling designers. The case is one of eco-innovation that works by fostering IS; a form of brokering to bring companies together in innovative collaborations, finding ways to use the waste from one as raw material for another. Many other cement-manufacturing companies in Zimbabwe have realised the value of gypsum in their manufacturing processes and these have added on to the symbiosis.

A review of whether the policies, strategies and initiatives are really making an impact is very vital, hence the need for sustainability assessments. **Figure 20.2** and **20.3** show a summary of other CE initiatives in Africa. The publications are trying to make CE initiatives visible to the world and what is shown in **Figures 20.2** and **20.3** just indicates that at least something is happening in every African country as far as CE is concerned. If funding can be provided to come up with an Atlas of CE practices in Africa, more initiatives can be recorded and added on to the previously recorded ones by organisations like ACEN.

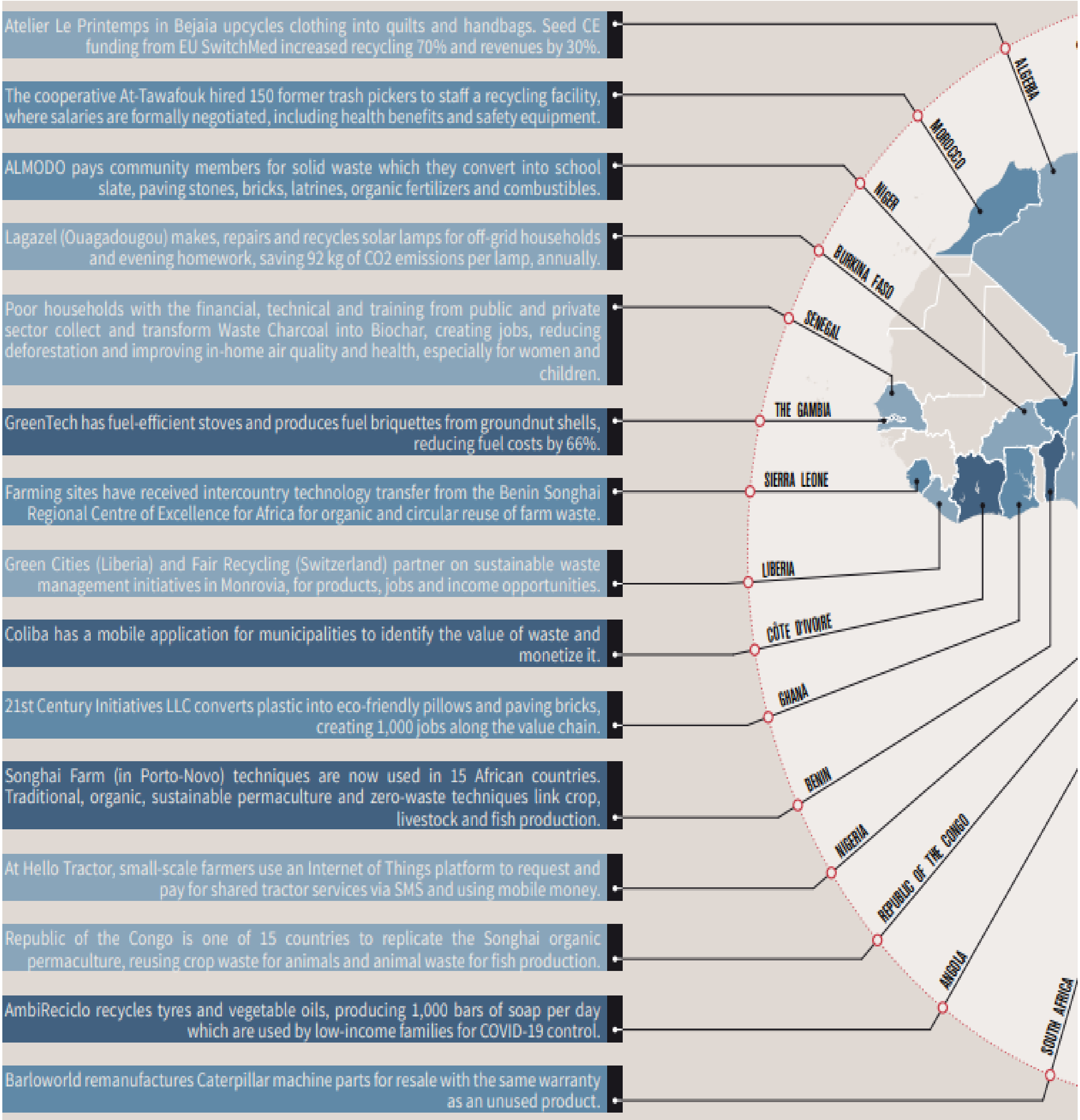

Figure 20.2 CE initiatives in Africa. Source: Patterson et al., 2021

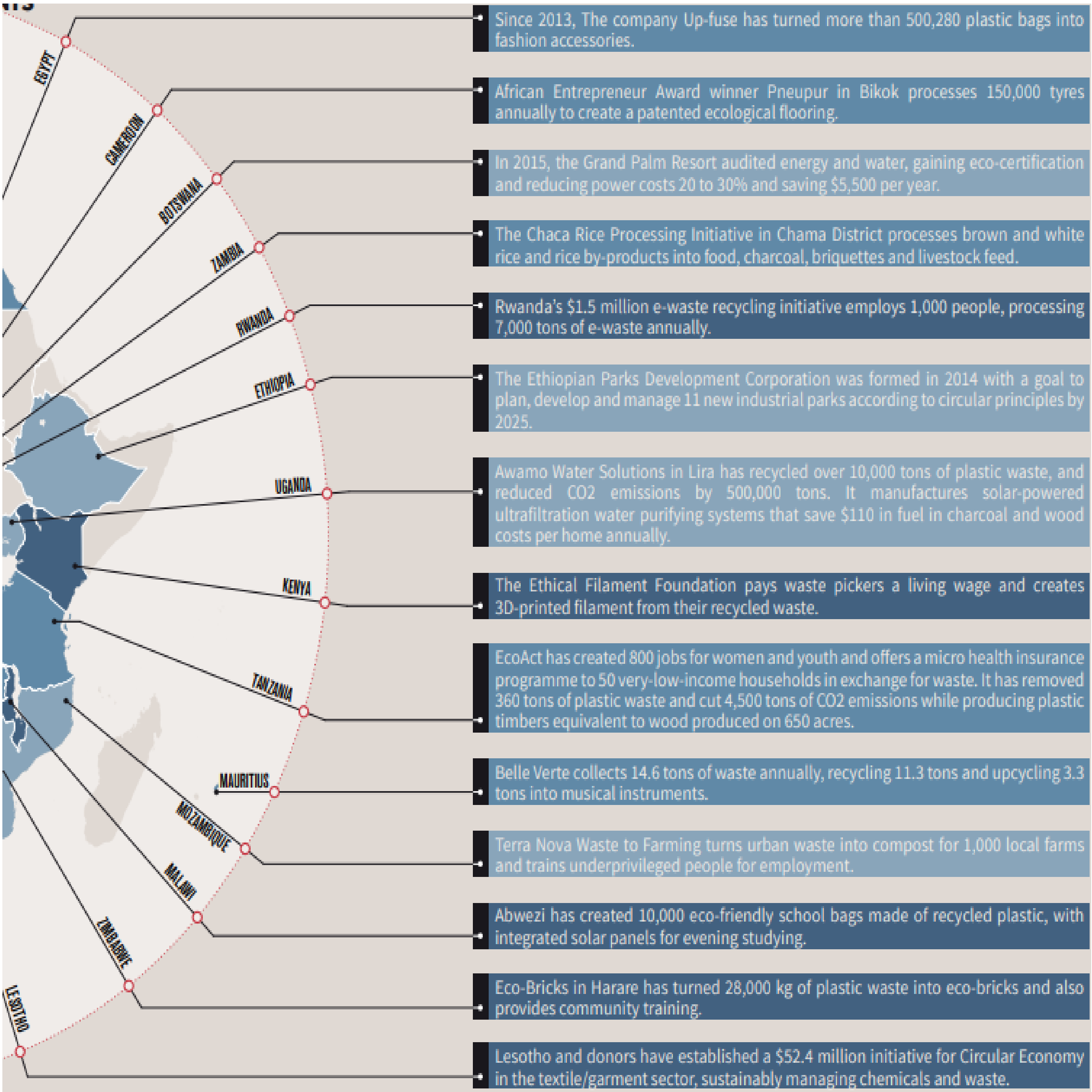

Figure 20.3 CE initiatives in Africa. Source: Patterson et al., 2021.

Some of the CE activities are at very low Technology Readiness Levels (TRL) and not recognised but are very significant in CE value chains, for example plastics bottles picking and sorting. According to Amorim de Oliveira, 2021, waste pickers and informal workers are already integral part of many existing circular systems. They recover and create value from waste – but their contributions are not valued by society. Waste pickers deal with many issues ranging from poor working conditions, poor health, poverty and social stigma. Despite their contributions waste pickers are often considered a social problem. Especially in low-income countries, the number of waste pickers is very high, mostly driven by the lack of better economic opportunities and low human development levels.

20.3 Enablers of CE IN AFRICA

20.3.1 CE enablers and policies in Africa

Several factors are driving the adoption of CE principles in Africa. One of the main drivers is the need to address environmental challenges such as climate change, pollution, and resource depletion. Africa is particularly vulnerable to these challenges due to its reliance on natural resources for economic growth and development. Therefore, adopting CE practices can help to reduce resource consumption, lower emissions, and minimize waste. Another driver of CE initiatives in Africa is the need for sustainable economic development. Many African countries face significant socio-economic challenges such as poverty, inequality, and unemployment. Implementing CE practices can create new business opportunities, create employment, and promote inclusive growth while minimizing negative environmental impacts.

Furthermore, there is growing awareness among African policymakers, businesses, and civil society organizations about the benefits of circular economy practices. Several international organizations, including the United Nations (UN), the EU, and the EMF, have also been promoting CE initiatives in Africa through funding, technical assistance, and capacity building (UNEP, 2018; EMF, 2013). A number of African countries have policies that speak to waste management and recycling and products (Rademaekers et al., 2020). This provides for a platform for CE to develop from, and thus expand to other sectors of interest such as food systems.

20.3.2 Anticipated and realised benefits of CE in Africa

CE provides a viable solution towards sustainable development by focusing on reducing waste and optimizing resource use. According to Christine Mwangi et al., 2023, the universal benefits of the CE are vast, as it represents a triple-win in many cases where environmental, economic, and social advantages are available through policies and measures that are capable of seizing on synergies. The benefits of CE initiatives can be summarised as follows:

Environmental Benefits: Africa's natural resources are under significant threat due to unsustainable exploitation, pollution, and degradation. Adopting CE initiatives will reduce the pressure on these resources and promote their conservation. For instance, recycling programs that encourage the collection and processing of waste materials such as plastic, paper, and metals will reduce the amount of waste that ends up in landfills and pollutes the environment. Furthermore, implementing renewable energy solutions such as wind, solar, and hydroelectric power will reduce reliance on fossil fuels and thus mitigate greenhouse gas emissions.

Economic Benefits: CE initiatives in Africa have enormous potential to create jobs and enhance economic growth. The circular economy model promotes the reuse of products and services, which can lead to the creation of new industries and markets. For instance, recycling plants can provide employment opportunities for many people who will be involved in the sorting, processing, and manufacturing processes. Additionally, using renewable energy sources can reduce the cost of electricity production, which in turn can lower the cost of goods and services.

Social Benefits: CE initiatives can also have significant social benefits by improving the livelihoods of communities and promoting social equity. For example, waste collection and recycling programs can provide income-generating activities for marginalized communities. Additionally, sustainable agriculture practices such as crop rotation and agroforestry can improve soil fertility and enhance food security, particularly in rural areas.

CE presents a viable solution towards sustainable development in Africa. The adoption of CE initiatives can lead to significant environmental, economic, and social benefits. Therefore, policymakers should prioritize the implementation of CE strategies to ensure a more sustainable future for the continent.

20.4 Issues of CE in Africa - Challenges and opportunities

20.4.1 Challenges of CE in Africa

According to Kirchherr et al., 2017, CE barriers are cultural, market, technological and regulatory related. Studies done in the GN countries have shown that barriers that affect CE advancement are poor communication, lack of support from top management, insufficient technical knowledge, no data integration, no recycling infrastructure, lack of sustainable product design and poor to no customer interest. There are also risks (operational, financial and environmental) that discourage investment in CE. The lack of customer interest, non-existent Environmental Management Systems (EMS), and no product standardisation in the market also act as a barrier to CE success (Gift et al., 2023). The African Development Bank Group 2020 (as cited by Christine Mwangi et al., 2023) postulated that, recently more than 50 per cent of Africa's economic growth has been driven by only five countries – Algeria, Egypt, Morocco, Nigeria and South Africa. Therefore, significant cultural and economic differences exist among African countries that influence their development, economic strategies, and readiness and capacity to adopt circular policies and technologies. However, in the African context, the barriers of transitioning to a CE, as observed from several case studies and literature can be summarised as follows;

- Historically the GN has relied on the cheap and available labour and land of the GS; therefore, economically this is still a viable and profitable arrangement, though environmentally unsustainable as was highlighted by Ahmed Shamira,(2022); Desmond & Asamba, (2019). African countries encounter barriers in implementing CE policies and business models because of power relations and vested interests embedded in global values chains. These value chains tend to create power imbalances and economic inequality in African countries that provide cheap raw materials as inputs for higher value products (Desmond & Asamba, 2019; GRID-Arendal, 2021 as cited in Christine Mwangi et al., 2023).
- The quality of recycled resource materials is currently inferior and costly to use in the production cycle, compared to using new material (World Economic Forum, 2021).
- A number of African countries still have structures that support linear practices through taxes, subsidies and government support which is similar to the findings of the Association of Southeast Asian Nations (ASEAN) (Melati et al., 2021).
- There is still technological disparity between the GN and the GS, whereby African countries are reliant on inefficient technologies to recycle or produce new goods.
- CE in many African countries in this study is largely waste management and recycling which is mainly an informal sector inundated with many social injustices.
- The largest corporates whose transition may have a CE impact are controlled by multinationals in the GN, thus African countries do not have control of the design impact or agenda (Dunmade, 2018). In Ghana the lack of an enabling environment, including financial and other incentives, is a major constraint for the creation of CE, particularly for entrepreneurs to set up informal repair businesses. The power exercised through EU Extended Producer Responsibility (EPR) legislation by Northern manufacturers in the value

chain will become a greater force for change and localised EPR legislation will be less important (Desmond and Asamba, 2019).

- Some of the technologies brought onto the market are relatively new and their effectiveness to a certain extent is unknown, which sort of serves as a deterrent for their adoption in some African countries (Mhlanga et al., 2022).
- SMEs comprise a large portion of the African countries economy, but these are generally lacking in technical expertise and infrastructural technology as they do not have the investment capital (Melati et al., 2021).

The adoption of CE practices in Africa faces several challenges. However, by addressing these barriers, it is possible to promote sustainable economic growth and resource utilization in Africa.

20.4.2 Greenwashing, social and environmental justice issues around CE in Africa

According to Greenpeace (www.stopgreenwash.org) – "greenwashing is the act of misleading consumers regarding the environmental practices of a company or the environmental benefits of a product or service. It involves use of deceptive and manipulative sustainable claims by companies to portray a superficial eco-friendly image than it actually is, by investing more resources on marketing its products as 'green' rather than actually minimizing its adverse impact on the environment (Aggarwal & Kadyan, 2011). Companies portray themselves as environmentally friendly without actually making any substantive changes to their operations. In Africa, this practice is prevalent as companies seek to capitalize on the growing interest in sustainability among consumers and investors. Such companies engage in superficial efforts, such as recycling programs or purchasing carbon offsets, while continuing to operate in ways that harm the environment. These companies have faced criticism for failing to address the root causes of environmental degradation, such as reducing carbon emissions or minimizing waste production.

Another issue associated with CE initiatives in Africa is social justice concerns. While promoting sustainability and reducing waste is critical, it is equally important to ensure that these activities do not exacerbate existing inequalities. According to Schroeder & Barrie, 2022, inclusiveness and social justice are key issues that need to be addressed for a successful CE transition to achieve positive social-ecological outcomes. Without addressing the human and social dimensions of the transition, the CE will not deliver on important social goals such as improved health, decent working conditions, or reduced inequality. It might even prevent a transition from taking place, since unjust and unequal societies are unlikely to be stable in political terms. The good news is that the need to address social issues in circular economy transitions, alongside environmental concerns and building the circular business case, is receiving more attention in the mainstream approaches.

In Africa, many CE initiatives often target informal waste pickers, who are typically vulnerable and economically marginalized. These people often rely on waste collection for their livelihoods but are excluded from formal waste management systems. Furthermore, CE initiatives can displace communities that rely on waste collection, leaving them without a source of income. This displacement can also lead to conflicts between waste pickers and formal waste management services, as seen in countries like Ghana, Kenya, and Nigeria.

Applying an environmental justice perspective or framework is an important first step to fill the social gap in the circular economy. The direct impacts of waste dumping and pollution on communities have been documented for decades in the United States, including cases of structural environmental racism. Similarly, in Europe the available

data dating back to the 1980s provide consistent indications that waste facilities are disproportionally located in areas with more deprived residents, or from ethnical minorities. The observed inequalities in exposure to waste and toxins, and the health impacts thereof, represent a case of environmental injustice (Martuzzi et al., 2010).
In Africa, environmental injustice is observed most of the times when E-waste from the GN is dumped as second-hand goods that will only work for very short periods and then require disposal. These are not usually disposed of properly yet they contain toxic materials that usually find themselves into the environment causing a health hazard especially to vulnerable groups that rely on surface waters.
While CE initiatives present an opportunity for Africa to promote sustainability and economic development, they must be implemented with caution. Companies must avoid greenwashing and prioritize substantive changes that reduce environmental harm. Similarly, social and environmental justice concerns need to be taken into account to ensure that marginalized communities are not further excluded from the benefits of sustainable development.

20.5 CE POTENTIAL IN AFRICA

20.5.1 Opportunity areas for CE in Africa

According to the International Resource Panel (2017) as cited in Desmond and Asamba, 2019, the current and projected increase of resource consumption in a globalised linear economy exceeds planetary boundaries. Raworth (2017) also added that the redistribution of wealth from North to South continues to be essential for the 300 million people who live in poverty in countries still classified as low-income, mainly in sub-Saharan Africa. In face of these situations, CE has the potential of producing cost savings and reducing exposure to market price fluctuations, increasing renewable energy and releasing valuable materials and energy in existing products (Ellen MacArthur Foundation, 2013b as cited in Desmond and Asamba, 2019).
CE strategies in the North risk concentrating power and wealth amongst a few actors in global supply chains to the detriment of poor nations. For example, the European Commission's Circular Economy Action Plan (European Commission, 2017) identifies setting eco-design standards for electronic and electrical equipment, addressing hazardous chemicals in material cycles, and improving circularity of plastics, as priorities for Europe's transition to CE. Much of this plan focuses upon the benefits to Europe through greater resource efficiency. However, a more circular economy in Europe can also deliver benefits for people in low-income countries if their needs are better considered when creating inclusive CE policies (Desmond and Asamba, 2019).
As postulated by Desmond and Asamba, 2019, CE may be a means by which greater value can be created in the South such as the remanufacturing of end of life products for re-export to customers in the North e.g. Barloworld's refurbishment of Caterpillar parts in South Africa. In the past many Global Value Chains (GVCs) have relied upon Africa to provide virgin resources for the manufacture of products in the North (e.g. rare earths and minerals from DRC for production of smartphones in China).
There are numerous and significant prospects for amplified circularity in Africa under the themes of food systems, packaging, the built environment, electronics, and fashion and textiles (World Economic Forum, 2021). This is majorly because Africa has a young and growing population, which will need food and agriculture being the continents biggest employer (Wachira Rhoda, 2022). The continent still serves as an electronics dumping ground for the GN (Desmond and Asamba, 2019; Wachira Rhoda, 2022). Plastic packaging is the favoured form of packaging making the packaging industry an area of concern and business opportunity for CE in Africa. CE also

provides an employment creation opportunity for the growing African population (Mhlanga et al., 2022), but the Green Alliance (Morgan and Mitchell, 2015) has argued that there is no strong evidence that this will be the case in Africa. As a result, the inequality that exists between the very poor without employment and those with permanent jobs may well continue in the CE.

20.5.2 Funding and technical support

African Agriculture and Trade Investment Fund (AATIF) has made use of concessional capital, guarantees, risk insurance, technical assistance funds, and design-stage grants as forms of funding. These arrangements attract investments from private sector and public funds. UN Environment (UNE) and Global Environmental Facility (GEF) is supporting activities that are inclined towards public sector financing, technical assistance, and advisory programmes and initiatives as was for the Republic of South Africa, Lesotho and Madagascar.

The African Circular Economy Alliance's (ACEA) main intervention pillars include policy advisory, leadership & advocacy, as well as projects and business scale-up. As the transition to a fully CE, the Alliance aims to harness immediate opportunities in Africa for increased circularity in sectors that will support the economy, jobs, and the environment on the continent in the long-term. Outside the signatory countries, its partners include the African Development Bank (AfDB), Global Environment Facility (GEF), World Economic Forum (WEF), African Circular Economy Network (ACEN), United Nations Environment (UNE), KAS Foundation, Platform for Accelerating the Circular Economy (PACE), and the Government of Finland and its affiliate innovation Sitra.

The African Circular Economy Fund (ACEF) is a multi-donor grants trust fund housed by the Climate Change and Green Growth Department of the AfDB. Its objective is mainstreaming the CE as an inclusive green growth strategy to help African nations to meet the goals of the Paris Agreement, SDGs and the African Union's (AU) Agenda 2063. Strategic Partners include WEF, EU, World Bank, Nordic Development fund, UNDP, the Circular Economy Innovation Partnership (CEIP), and ACEN (Ellen Macarthur Foundation {EMF}, 2021).

20.5.3 Policy support

According to a publication by Wetterberg et al., 2022; programmes such as the SWITCH2CE project is working with European and Moroccan stakeholders to pilot Morocco's first Poly-Ethylene (PET) bottle-to bottle recycling process. The professionalization and empowerment of informal waste pickers will be key to ensuring consistent high-quality collection of PET. The pilot will seek to address social justice issues facing informal workers including

- Lack of formal legal recognition, which results in stigmatization and limits their ability to collect waste directly from householders;
- Lack of access to land to legally conduct collection and sorting operations;
- Unequal power relationships with waste traders;
- Exposure to the volatility of the recycled PET market;
- Lack of worker safety and training; and
- Limited supply chain traceability and transparency.

Other SWITCH programmes, such as SWITCH Africa Green, which is funded by the EU and implemented by the UNEP in partnership with the African Roundtable on Sustainable Consumption and Production (ARSCP), are supporting CE activity in Burkina Faso, Ethiopia, Ghana, Kenya, Mauritius, South Africa and Uganda. Lessons sharing, improvement of regional harmonization of policies, and increasing national level impact in biogas, e-waste management, organic agriculture (which can include reuse of organic materials), green manufacturing, eco-industrial parks and standards in labelling has been the major outcomes. The programme enhances access to green financing and innovative solutions as well as enables the development of policies and standards. It also contributes to awareness raising and facilitates networking.

Some countries are uniting to develop regional policies to advance CE. For instance, in 2015, the East African Community (EAC) announced a ban on imported second-hand clothes from 2019 onwards. The low-priced imports hinder local markets and regional development. However, after complaints from international exporters, who argued that this decision would harm international trade agreements, the proposal is now only for an indirect ban. This compromise includes increasing tariffs, which are intended to disincentivize imports of second-hand clothing, while incentivizing locally produced products and industries. CE policy challenges include untangling policy signals and instruments that may overlap and even contradict one another.

20.6 Conclusions and recommendations

The adoption of CE principles can help African countries address environmental challenges, promote sustainable economic development, and create new business opportunities. While several challenges exist in implementing circular economy practices in Africa, there are significant opportunities for growth and innovation in the sector. By implementing supportive policies, strengthening infrastructure, and increasing financing options, Africa can become a leader in the transition to a more circular economy.

According to Desmond & Asamba, 2019, government policy in Africa has a major role to play at both national and local level. There is little CE specific legislation and so regulations and policies in operation and policies are generally focussed on climate change mitigation, the Green Economy (GE), and waste management. Proposals are often presented but are still awaiting promulgation into government policy and legislation. There are few systematic studies of CE policies in Africa and so identification of policies currently relies on informal research approaches. Further research is required to identify the extent and impact of sustainability legislation and policies such as waste management, recycling, extended producer responsibility, repair and renewable energy.

Networks such as the African Circular Economy Alliance (development of national and local government policy) and the Africa Circular Economy Network (strategic application in business) working in collaboration will be able to facilitate this transition process. For Africa to transition from a linear to a circular economy, barriers need to be overcome through extensive collaboration between the various actors who each have a specific role to play (Desmond and Asamba, 2019).

The power of hubs for CE is being recognized globally. CE hubs and their activities that can be summarised by network governance can be found all over the world in different socio-cultural and political environments. Efforts are also underway in Africa. Multi-stakeholder CE platforms exist already e.g. in Nigeria (Circular Lagos), Rwanda and South Africa. Having (a) hub(s) in a country is an advantage as it allows them to harness local circular potentials unique for each country or region. Setting up a CE hub can be flexible and should be tailored to local conditions and stakeholders, including public, private, or public-private partnerships (Vesna et al., 2022).

In their publication of the side event on Boosting Circular Economy in Africa through Hubs Learnings from the WCEF 2022, in Kigali – Rwanda, Vesna et al., 2022 identified and documented several activities that hubs could carry out in African countries. They also documented several options on how to establish a CE hub in African countries and who should be the stakeholders. As a final thought Vesna et al., 2022, postulated some of the following selected points

- Africa is having an enormous opportunity to foster truly sustainable development through circular economic proliferation.
- Europe can assist Africa in fostering the CE through close cooperation and sharing best practices. Engaging in fair and inclusive trade with African countries can substantially support their CE - based sustainable development.
- National and regional African hubs would play a crucial role in preserving and upscaling the existing CE practices. For an inclusive transition to a CE, hubs should be a meeting point for all the stakeholders - government, business, knowledge institutes as well as citizens.
- Respecting the socio-economic situation in Africa, a special focus of the hubs should be given to the informal sector and youth. Hubs could support all the actors in addressing social needs through the lens of a CE.

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Chapter 21. Circular Economy Transitions in Africa: a policy perspective

Sally-Anne Käsner, Katharina Gihring, Peter Desmond and Catherina Schenck

Abstract

To effectively implement the circular economy in Africa, it is crucial to tailor its principles to address Africa's unique developmental challenges. This requires a citizen-focused approach that prioritizes social equity, quality of life, access, and improved service delivery. Engaging with the aspirations of Africa's growing middle class is of utmost importance. African cities, as they urbanize, offer ideal opportunities to implement holistic circular economy models that can inspire new and sustainable urban living. This paper acknowledges the diverse voices and perspectives in Africa, and presents an overview and does not claim to represent the only viewpoint. Merely adopting a technocratic approach to implementing the circular economy in African cities is inadequate. Proponents of the concept must prioritize people and equity as indispensable elements in achieving a circular economy. Many instances and examples already demonstrate the implementation of circular economy principles in African contexts. The question arises: Can policies further support and retain these approaches, or are alternative strategies required to avoid simply following the development path of Europe and other more advanced economies?

Keywords: circular economy, Africa, regenerative, policy, informal sector

> This contribution addresses the unique developmental challenges in African cities through the lens of circular economy principles, while prioritizing social equity and citizen engagement.

21.1 Introduction: The Circular Economy in the African context

In the GN, particularly Europe, the circular economy (CE) narrative has primarily focused on waste management, recycling, and cost savings, with product redesign and remanufacturing emerging as recent developments (Desmond and Asamba, 2019). Multinational organizations such as Philips, Desso, Interface, and Renault have implemented CE principles in their business models, incorporating concepts like "Pay Per Lux","carpet tile renting", and remanufacturing (Ellen MacArthur Foundation, 2013a).

In contrast, Africa's development path has primarily emphasized conventional industrialization, neglecting high-value activities and advanced processing methods (United Nations Economic Commission for Africa, 2016). This has resulted in a heavy reliance on imported high-value products and weak linkages with the knowledge economy, research and development, and advanced technology (ibid).

To address this issue, several African countries are now shifting towards developing "greener" economies by focusing on local product design, promoting reuse and repair practices, and reducing negative environmental impacts and ecological scarcities. While discussions on the benefits of a CE approach are still emerging in Africa, many argue that Africa has been naturally practicing CE principles for decades through repair and reuse practices, sustainable farming, and material beneficiation.

The CE is increasingly recognized as a policy framework that maximizes the value of resources for economic development and job creation, rather than solely focusing on waste management and environmental outcomes. As few CE related policies have been developed on the continent (e.g., Extended Producer Responsibility) and Africa needs to find its own CE narrative the question arises: Can policies further support and retain these approaches, or are alternative strategies required to avoid simply following the development path of Europe and other more advanced economies?

Global trade plays a significant role in shaping Africa's engagement with the CE. Africa, as a continent rich in natural resources, has historically been positioned as a supplier of raw materials to the global market. This reliance on exporting raw materials perpetuates a linear economic model with limited value addition and insufficient linkages to local industries and economies.

However, there is growing recognition of the potential benefits of the CE in Africa's trade dynamics. Adopting CE principles can enable African countries to maximize the value of their resources, promote local manufacturing and processing, and reduce dependency on imports of high-value products. By transitioning towards a more circular approach, Africa can strengthen its position in global trade by adding value to its own resources and retaining economic benefits within the continent. There is recognition that the transition to renewable energy will need large supplies of critical metals such as cobalt, lithium, and nickel, and mineral extraction is set to increase by about 500% (The World Economic Forum, 2022). At the World CE Forum 2023, discussions have been initiated in earnest around investigating alternative business models linked to materials extraction and using blockchain to retain ownership and value so that the economic benefits of beneficiating these mineral resources are not lost to the African economies from which they are extracted. This is a developing area.

Moreover, the CE can contribute to addressing Africa's trade imbalances by promoting intra-African trade and regional integration. By developing local CE ecosystems, African countries can enhance economic cooperation, exchange circular products and services, and establish sustainable supply chains within the continent. This can foster economic diversification, work opportunities, and improved resilience to global market fluctuations.

International collaboration and partnerships are also crucial in advancing the CE in Africa's global trade. Knowledge sharing, technology transfer, and investment support between both industrialised and emerging economies can facilitate the adoption of circular practices and promote sustainable trade networks. This collaboration can enable

Africa to leverage as well as share its resources, talents, and innovative solutions to become a key player in the global CE movement.

The African Continental Free Trade Area (AfCFTA) (African Continental Free Trade Area, 2023) is an initiative under Agenda 2063[37]. It is a comprehensive trade agreement encompassing various sectors, including digital trade and investment protection and remove trade barriers within Africa.

The AfCFTA includes 55 African Union member countries and eight Regional Economic Communities with the aim to boost intra-African trade, particularly in value-added production, enhance Africa's competitiveness, and economic integration by promoting trade and investment across the continent.

The AfCFTA officially came into effect on May 30, 2019, following the deposit of Instruments of Ratification by 24 member states. It was launched during the 12th Extraordinary Session of the AU Assembly of Heads of State and Government in Niger in July 2019. Trading under the AfCFTA commenced on January 1, 2021, marking an important milestone in Africa's journey towards economic integration and regional cooperation.

Seemingly missing from the AfCFTA is the inclusion of the CE or any reference to sustainable development. Van der Ven and Signé (2021) authored a Policy Brief proposing that it is not too late for the AfCFTA to be an instrument for advancing green growth into the agreements and the ongoing market access negotiations under Phase I (tariff concessions and services schedules). Whilst the term of "green growth" was stated by Van der Ven and Signé, perhaps the CE principles should be included instead?

21.2 Africa's circular economy policy landscape

Unlike the European Union, Africa currently lacks continent-wide specific CE policies. However, there are opportunities within the African Union and national policy frameworks to promote the CE, and there is growing political will to support its implementation.

Agenda 2063, officially adopted by the African Union Assembly in 2015, serves as a collective vision and roadmap for a prosperous and united Africa. While the CE is not explicitly mentioned in Agenda 2063, certain actions within the agenda, such as transforming economies through value addition and addressing climate change and the environment, can pave the way for CE initiatives.

Following this, there is a rising political will to implement the CE in Africa, evident through its inclusion in various international and pan-African initiatives. The African Circular Economy Alliance (ACEA), formed by South Africa, Rwanda, and Nigeria, aims to advance CE practices through policy frameworks and regulations. Supported by organizations like the World Economic Forum, the Global Environment Facility, and the African Development Bank (AfDB), the ACEA plays a crucial role in promoting CE principles.

[37] Agenda 2063 – The Africa we want - is the continent's strategic framework that aims to deliver on its goal for inclusive and sustainable development and is a manifestation of the pan-African drive for unity, self-determination, freedom, progress and collective prosperity pursued under Pan-Africanism and African Renaissance. The development of Agenda 2063 was inspired by previous work undertaken The Organisation of African Unity (OAU), the precursor of the African Union; to prioritise inclusive social and economic development, continental and regional integration, democratic governance and peace and security amongst other issues aimed at repositioning Africa to becoming a dominant player in the global arena. Source: African Union. Agenda 2063: Africa we want. [Online]. Available at: https://au.int/agenda2063/overview [12 Nov 2023]

In November 2019, the African Ministerial Conference on Environment (AMCEN) endorsed the Durban Declaration, the first continent-wide policy explicitly incorporating the CE. Supported by the ACEA, the Durban Declaration acknowledges the value of the CE in driving economic development, job creation, and environmental sustainability. It calls for increased awareness, policy development, capacity building, and private sector investments to accelerate the transition to a CE in alignment with Agenda 2063.
Research undertaken in 2020 for ACEA by Dalberg identified five sectors in Africa with immediate opportunities for increased circularity, jobs creation, and environmental protection. These were published in a report referred to as the "Five Big Bets for the Circular Economy" (African Development Bank Group, 2021) and includes:

- Food systems: This bet focuses on reshaping the food production and consumption cycle to reduce waste, improve resource efficiency, and promote sustainable agricultural practices. It involves initiatives such as reducing food loss and waste, promoting regenerative farming, and adopting circular approaches in the entire food value chain.
- Packaging: The packaging sector aims to transition from a linear model of single-use packaging to a circular model that emphasizes reuse, recycling, and sustainable packaging materials. This includes promoting packaging design that enables easy recycling, implementing effective waste management systems, and encouraging the use of recycled materials.
- Built environment: This bet revolves around creating a circular approach to construction and infrastructure development. It involves adopting sustainable building practices, utilizing renewable and recycled materials, promoting energy efficiency, and encouraging the reuse and recycling of construction waste.
- Electronics: The electronics sector focuses on improving resource efficiency, reducing electronic waste, and promoting the sustainable management of electronic products throughout their lifecycle. This includes initiatives such as designing products for durability and repairability, promoting responsible e-waste management and recycling, and encouraging the adoption of circular business models in the electronics industry.
- Fashion and textiles: This bet aims to transform the fashion and textile industry by promoting sustainable and circular practices. It involves promoting responsible sourcing of materials, reducing textile waste through recycling and upcycling, adopting circular business models such as clothing rental and repair services, and raising awareness about sustainable fashion choices.

Currently, there is limited specific legislation targeting the CE in Africa. Existing regulations and policies primarily focus on climate change mitigation, the green economy, and waste management. The UN 2030 Agenda for Sustainable Development and the UNFCCC COP 21 Paris Agreement serve as foundational global agreements guiding relevant policy and legislation development. However, many proposed CE initiatives are still awaiting incorporation into government policies and legislation.
An initiative that has gained some traction within Africa is the "green economy". "A green economy is defined as low carbon, resource efficient and socially inclusive. In a green economy, growth in employment and income are driven by public and private investment into such economic activities, infrastructure and assets that allow reduced carbon emissions and pollution, enhanced energy and resource efficiency, and prevention of the loss of biodiversity and ecosystem services" (UNEP, no date). African countries are at different stages of implementing the green economy, with some integrating certain aspects, while others, like Ethiopia, Kenya, and Rwanda, have established green economy strategies. However, the legal and regulatory framework to foster the green economy is still

underdeveloped in many African countries, and mechanisms for facilitating the transition are not yet fully in place. The most promising markets for the green economy often revolve around agriculture, bio-trade, sustainable tourism, and renewable energy. This can be attributed to the social and economic challenges in Sub-Saharan Africa, where rapid adoption of new concepts may conflict with development and growth objectives (Klein and Reiher, 2016). The green economy provides a good segway to the CE, so countries that have good green economy strategies in place, will find it easier to move to circular practices.

There are few systematic studies of CE policies in Africa and so the identification of policies currently relies on informal research approaches. **Figure 21.1** summarises some of the CE-related policies that are in existence for a selection of African countries, however, is two years old (GRID-Arendal, 2021 as sourced from Chatham House 2021).

- National CE policies include any national CE policies already in place as well as national green growth or sustainable development strategies which integrate CE principles.
- Product policies are any policies that support circular practices relating to the design, manufacture, distribution or import of specific products and materials (mostly plastic bans or levies).
- Extended producer responsibility policies place the responsibility for the environmental impacts of products throughout the product life cycle on producers and is often applied to the collection, processing and reuse of waste.
- Waste management and recycling policies encourage circular practices relating to the management of waste covering generation, segregation, transfer, sorting, treatment, recovery and disposal.
- Fiscal policies include government tax and spending policies that incentivize circular practices.

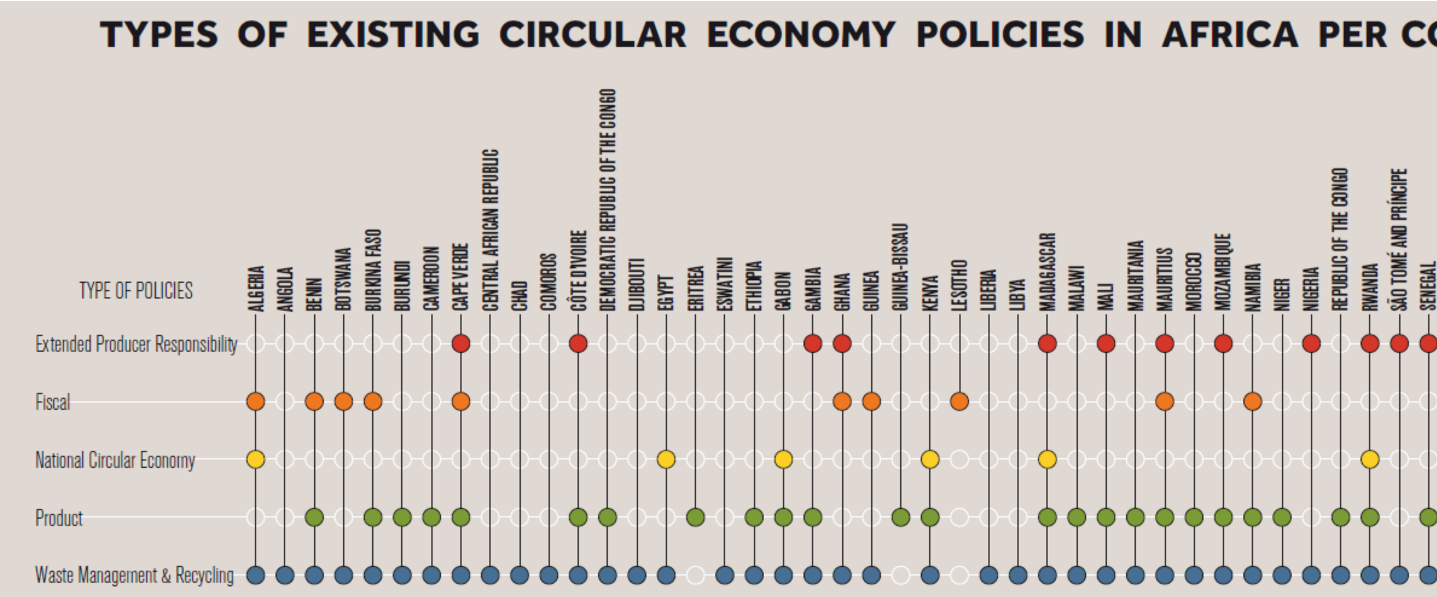

Figure 21.1 CE-related policies, regulations and initiatives in a selection of African countries (Source: GRID-Arendal, 2021)

21.3 Current status of the circular economy

Although large businesses like Unilever, Nestle, Veolia, and Caterpillar are engaged in CE activities in Africa, the transition to a CE is primarily driven by private business and practitioners on the ground, including NGOs, consultancies, entrepreneurs, and small and medium enterprises (SMEs). These local innovators and SMEs have developed some of the continent's most notable CE innovations and technologies, designed with the local context in mind, emphasizing decentralization, labor-intensive processes, and cost-effectiveness.

The private sector, particularly SMEs, play a leading role in driving the CE transition in Africa. Industrial symbiosis, facilitated by programs like the Switch Africa Green Programme and the British High Commission Prosperity Fund Project, is one of the fastest-growing CE activities on the continent. The African Circular Economy Network (ACEN) is a key organization that brings together CE practitioners from across Africa to share knowledge and build an evidence base. With representation from 42 countries, ACEN plays a significant role in promoting the existing CE case studies from Africa as well as assisting to drive further transition.

The transition to a CE is seemingly driven by changes influenced by trade with global markets and the shifts required by EU Directives and not necessarily changes in policy on African soil.

Organisations that have influence on Africa's transition and promoting the CE include the ACEA, the European Union, the governments of Nigeria, South Africa, Rwanda, Ghana, and Morocco, the District of Abidjan in Ivory Coast, the World Economic Forum and its PACE platform, ICLEI Africa, and UNEP Africa. By embracing a CE strategy, Africa has the opportunity to leapfrog and avoid the linear lock-in (Sopjani, et al, 2020) of resource-intensive practices associated with the linear economy, which has historically driven growth in the GN (Desmond and Asamba, 2019). Chatham House developed "circular economy.earth" (Chatham House, 2021) to allow users to explore the policy and trade dynamics associated with transitioning from linear to circular economic models as well as provide analyses of the opportunities and trade-offs associated with such transitions. Chatham House has initiated a process to develop a global CE roadmap with the specific focus to be (**Figure 21.2**):

- Developing a shared vision for an inclusive CE
- Identifying and acting on essential areas for mutual collaboration and coordination.
- Raising global ambition.

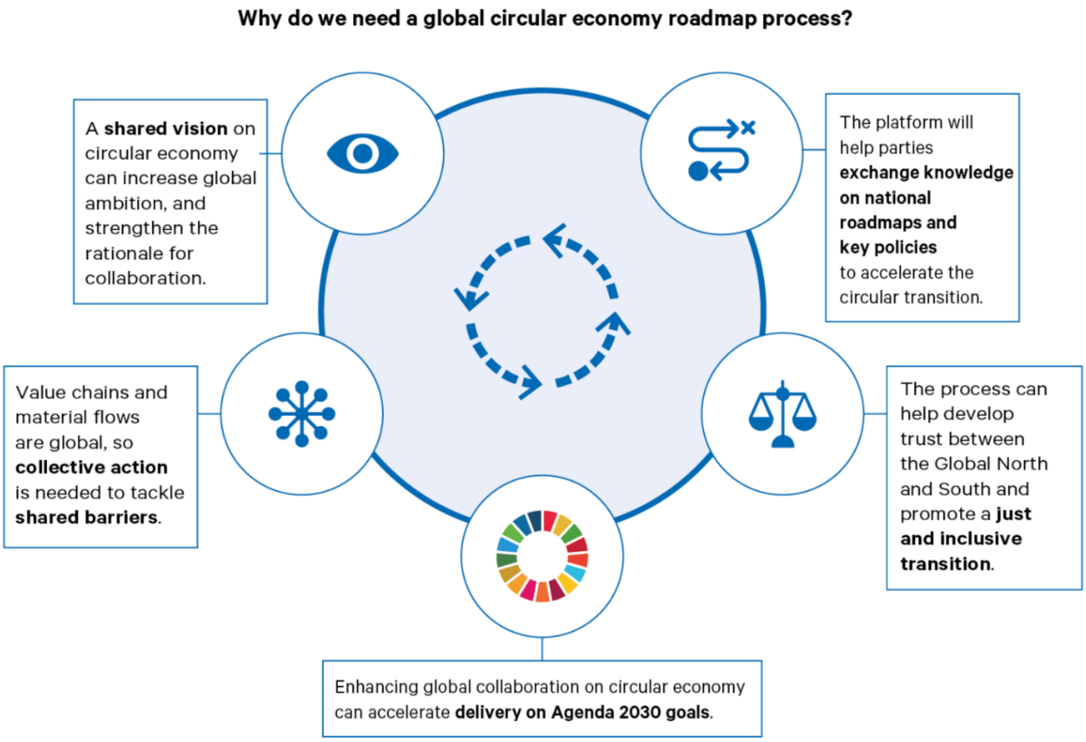

Figure 21.2 Global inclusive CE roadmap process (Source: Chatham House, 2021)

In addition to trade and the effect and impact that trade has on the growth and development of African economies, urbanisation plays a vital role in terms of how cities develop. Urbanization is a significant global trend shaping the 21st century, with the urban population projected to reach 66% by 2050, primarily driven by Africa and Asia. Africa, the second-largest continent, consisting of 54 countries, is expected to have an estimated population of 1.5 billion by 2025 and nearly 2.5 billion by 2050, with approximately 55% living in urban areas. This represents a substantial increase compared to less than 10% in 1950 (United Nations, 2018). However, Africa's urbanization varies across countries and income levels, and the urban-rural welfare gap does not necessarily narrow with urbanization (**Figure 21.3**).

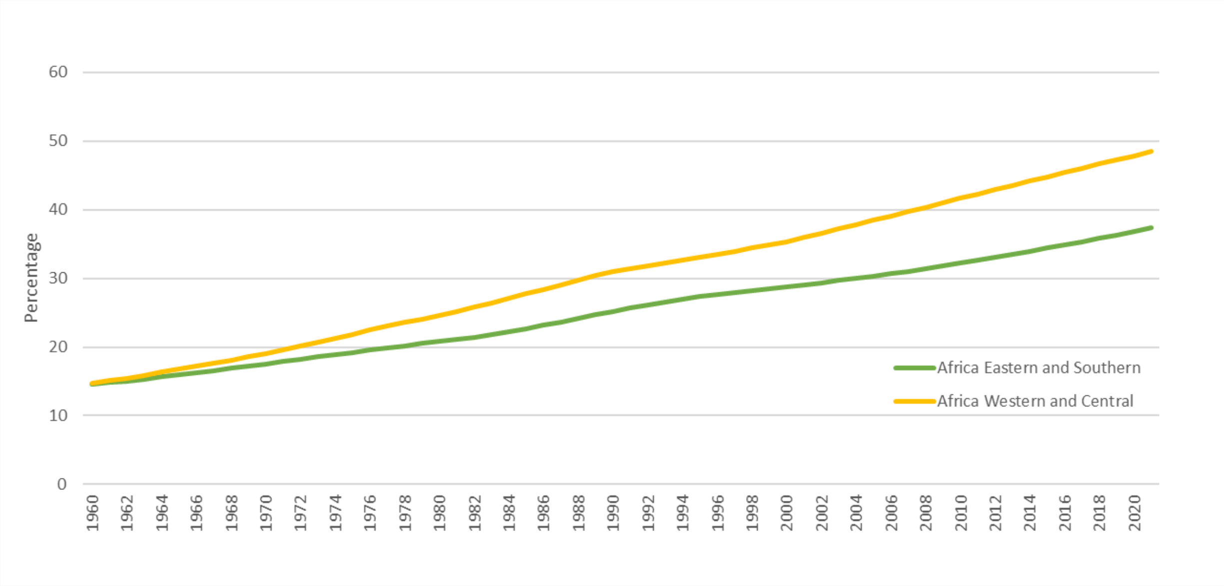

Figure 21.3 Urban population (% of total population), 1960-2020 (World Bank, 2021)

The rapid and unplanned nature of urbanization in Africa poses numerous challenges, as many municipal authorities lack the capacity to accommodate growing urban populations and provide basic services (World Economic Forum, 2017). Poor governance, inadequate infrastructure, historical institutional arrangements, and political instability contribute to the deficiencies in urban services and the proliferation of slums and sprawling residential areas (Güneralp, et al., 2017). These complexities present both challenges and opportunities for implementing CE principles in African cities.

Proper urban planning and development (including adequate infrastructure and taking distance into account) with a focus on circular material flows can mitigate the negative environmental impacts of urbanization while maximizing its potential benefits, such as reduced travel distances and preserved land. However, African cities are characterized by a dominant informal economy, with a significant proportion of non-agricultural workers engaged in informal employment, particularly women in self-employment.

Overall, the urbanization trend in Africa necessitates comprehensive planning based on CE principles for infrastructure development to ensure inclusive and environmentally conscious urban growth.

21.4 Considerations for a Just transition to a circular economy in Africa

Several critical enablers are required to facilitate the transition to a CE in Africa, including:

- Political will and leadership: Strong political commitment and leadership are essential to drive the CE transition. Governments and policymakers need to prioritize and support the development of CE policies, strategies, and initiatives. This has been demonstrated by the African Circular Economy Alliance.
- Stakeholder collaboration and engagement: Collaboration among various stakeholders is crucial for a successful transition. This includes cooperation between governments, businesses, civil society organizations, academia, and local communities. Engaging all relevant stakeholders in the decision-

making process ensures a comprehensive and inclusive approach. Many initiatives are underway in South Africa, Rwanda, Ghana and others, however additional integration would be encouraged. The African Circular Economy Network is attempting to bridge the gaps.

- Policy and regulatory frameworks: Developing and implementing supportive policy and regulatory frameworks is vital, from a continental, regional to a local scale and international agreements. This involves creating an enabling environment that incentivizes CE practices, such as through tax incentives, subsidies, and extended producer responsibility programs. Clear and consistent regulations are necessary to address barriers, facilitate investment, and encourage innovation. Along with this though is the requirement for consistent enforcement, which is not always the case in many African countries.
- Access to finance and investments: Adequate financing mechanisms and investments are needed to support CE initiatives. This includes access to affordable capital, funding for research and development, and support for small and medium-sized enterprises (SMEs) and startups working on CE solutions (existing or proposed). Finance and investments can be in various forms, for example, the European Green Deal. While it offers opportunities for Africa in terms of sustainable investments and technology transfers, there are also concerns about potential negative impacts on African economies. It is crucial for African countries to engage actively with the European Green Deal, ensuring that their interests are protected and that they can benefit. Collaboration between Europe and Africa is essential to address climate change and achieve sustainable development goals (Usman et al, 2021).
- Capacity building and education: Building the necessary skills, knowledge, and capacities is crucial for the successful implementation of a CE. This includes training programs, educational curricula, vocational training, and awareness campaigns to promote understanding and adoption (and in some cases the continuation) of circular practices among individuals, businesses, and communities.
- Infrastructure development and technology transfer: Developing and upgrading infrastructure, including material management facilities, recycling centers, and renewable energy systems, is essential. Technology transfer and knowledge sharing, both domestically and internationally, can accelerate the adoption of appropriate and sustainable technologies for circular practices.
- Research and innovation: Encouraging research, development, and innovation is vital for advancing CE solutions tailored to the African context. Research institutions, universities, and innovation hubs play a crucial role in generating knowledge, developing new technologies, and fostering entrepreneurship in the CE sector.
- Access to markets and value chains: Facilitating access to markets and integrating African businesses into regional and global value chains is essential. This requires strengthening trade networks, promoting market linkages, and creating platforms for collaboration and knowledge sharing among businesses operating in CE sectors.

By addressing these critical enablers, Africa can foster a conducive policy and fiscal environment for the CE to thrive, unlocking economic opportunities, promoting sustainable development, and addressing environmental challenges.

21.5 Concluding remarks

In summary, the risks posed by deglobalization and geopolitical conflict highlight the importance of targeted coordination and collaboration at the global level for a globally inclusive CE. Collaborative efforts in areas such as circular finance, supply chain transparency, standards, trade policy, and knowledge exchange can overcome challenges and create opportunities.

Clear and consistent policies at national, regional, continental and international levels are crucial for creating an enabling environment for CE practices. The African Circular Economy Alliance is a positive step to harmonise and focus the transition to circularity for the continent. The current policies related to the CE in Africa tend to focus on the environment and waste management and implementation across the continent varies.

Africa is a resource rich continent with countries dependent on the extraction of materials traded globally. Often changes in the economy is linked to change in trade policy or renegotiated trade relations. Specific changes in policy alone is not likely to transition to circularity. Greater collaboration and consensus-building among the global community is therefore necessary. These include fair and equitable trade policy, supply chain transparency and traceability, circular finance, and harmonised standards and definitions. Facilitating knowledge exchange on circular roadmaps and policies would also be highly beneficial in promoting best practices and shared learning.

Despite the clear benefits of enhanced coordination and collaboration, there is currently no single multilateral process or organization specifically dedicated to fostering a more harmonized and coordinated global transition to a CE. Establishing such mechanisms would help facilitate international cooperation and provide a platform for addressing common challenges and pursuing collective action.

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Chapter 22. Circular economy transition in European Union countries

Chiara Vassillo

Abstract

The Circular Economy (CE) stands out as a focal point within the developmental agenda of the European Union (EU) and constitutes an integral component of the EU's overarching industrial strategy. Positioned as an indispensable element, the transition towards a more circular economy represents a crucial contribution to the EU's endeavours in fostering a sustainable, low-carbon, resource-efficient, and competitive economic landscape. The concept of CE gained considerable prominence in Europe following its incorporation into EU policy and strategy in 2014, underscored by the introduction of Circular Economy Action Plans by the European Commission in 2015 and 2020.

In the past decade, the Circular Economy has garnered heightened attention, propelled by the challenges outlined in the Circular Economy Action Plans. Member States have undertaken substantial efforts to recalibrate their social and economic activities towards embracing circularity, resulting in transformative shifts characterized by the emergence of novel business models and opportunities. This comprehensive analysis delves into the initiatives, policies, and programs related to the CE across all European countries. Particular emphasis is placed on scrutinizing national recovery plans and various initiatives within the purview of the Just Transition framework. By exploring these facets, the study aims to offer a nuanced understanding of the diverse approaches and strategies adopted by EU member states in navigating the landscape of CE, shedding light on the intricate interplay between policy frameworks, national recovery plans, and the broader framework of just transition.

Keywords: Circular economy, European Union, Just transition, Member States.

This chapter endeavours to elucidate the diverse array of instruments and models utilized across various European countries. A comprehensive analysis of these nations will be conducted, shedding light on significant nuances and distinctions.

22.1 Introduction

The CE is an economic model crafted to eliminate waste by design and optimize resource usage. It encompasses practices such as reducing, reusing, recycling, and recovering materials to establish a closed-loop system. The EU

has been at the forefront of promoting the CE, implementing strategies and initiatives aimed at fostering sustainability, resource efficiency, and environmental protection.
The literature, as well as the EU directive and recommendations, consistently highlight that most of the challenges related to the transition to a Circular Economy (CE) revolve around waste, including its production, reuse, and disposal. The European Commission (2019a) considers waste management a strategic issue for all 28 EU Member States in their transition from a linear to a circular economy. Liu et al. (2017) emphasized the importance of sustainable waste management within the framework of the CE, focusing on the "Reduce, Reuse, and Recycle" (3R) principles. They underscored the necessity of establishing an appropriate legal framework and investing in technologies for efficient resource recycling and waste management infrastructure. Furthermore, Iacovidou et al. (2017b) introduced an innovative approach called "Complex Value Optimization for Resource" (CVORR), aimed at assessing how complex value is generated, lost, and distributed in resource recovery from waste systems. Specifically, municipal waste, even though it represents a relatively small portion (7-10% by weight) of the total waste generated in the EU, is one of the most challenging types to manage due to its mixed and dispersed nature (Malinauskaite et al., 2017). Within municipal waste, food waste emerges as a substantial untapped recyclable component, accounting for nearly 88 million tons generated annually. This wastage not only results in the loss of valuable and often scarce resources such as water, soil, and energy but also contributes to climate change. Only a small fraction (6.3%) of food waste worldwide is diverted from landfills and incineration for composting, making up 22% of discarded municipal waste (European Parliament, 2017b). Additionally, in alignment with the Waste Framework Directive (European Parliament, 2018), builds upon the preceding Waste Framework Directive, which was originally Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives, there is a target set for EU Member States to recycle and prepare for reuse 50% of municipal waste by 2020.
Material recycling, composting, and digestion are identified as strategic drivers and strengths of the CE policy in Europe by the Directive. Minelgaitė and Liobikienė (2019) emphasized the significance of reducing, reusing, and recycling behaviours as effective tools for addressing the waste issue in the EU. They also stressed that countries aiming to minimize waste generation should focus on promoting efficient consumption and production patterns. However, these actions, while crucial, do not guarantee a complete transition to circularity. Winkler (2011) identified two structural barriers to improving circularity in terms of product reuse. The first barrier involves a significant accumulation of used materials as in-use stocks, while the second concerns the substantial number of unrecycled materials sent to landfills.
Reusing used materials as secondary raw materials is another crucial aspect, as it can enhance the efficiency and resource sustainability of production processes, contributing to market competitiveness. The 3Rs strategy is not only an environmental but also a market-driven manufacturing strategy (Brissaud and Zwolinski, 2017). According to the European Commission's Circular Economy package (European Commission, 2015b), increasing the use of secondary raw materials can open new markets, reduce production costs, boost business competitiveness, drive innovation, create jobs, and stimulate economic growth. To assess the progress toward a circular economy, quantitative indicators are useful but should be integrated into comprehensive sets that consider their combined effects and the intricacies of system dynamics (EASAC, 2016; Geng et al., 2012).
The concept of a "Just Transition" in the context of the Circular Economy in the EU entails a comprehensive and equitable shift from linear economic models to circular ones, ensuring fairness for all stakeholders involved. This concept is often associated with environmental and social justice considerations. The principles of a Just Transition highlight the necessity for an inclusive and fair process that takes into account the impacts on workers,

communities, and regions affected by the transition to a circular economy. This involves addressing social inequalities, supporting workers in high-polluting industries, and ensuring that the transition towards sustainability leaves no one behind.

This chapter adopts a macro-level approach, focusing on a country-level perspective. Consequently, it is oriented towards observing the activities of policy actors and examining the associated outcomes.

22.2 Material and Methods

For this chapter, a total of 35 official reports have been analysed, including documents from the European Commission (2015a, 2015b, 2016a, 2016b, 2016c, 2016d, 2017a, 2017b, 2017c, 2018a, 2018b, 2018c, 2018d, 2019a, 2019b, 2019c, 2019d), the European Parliament (2017a, 2017b, 2018, 2019), the European Environment Agency (2013, 2018), Eurostat (2017a, 2017b, 2019a, 2019b, 2019c), the European Investment Bank (2017), the European Circular Economy Stakeholder Platform (2018, 2019), the European Economic Area (2019), OECD (2016, 2017), and the United Nations Environment (2019). Moreover, an extensive literature review has been conducted to delve into the subject matter, aiming to furnish a comprehensive overview of the current state and advancements in CE and the concept of a Just Transition to Circular Economy (JUST2CE) within the EU. The scrutiny involved the analysis of approximately 70 scholarly articles. It is worth noting that not all articles have been explicitly cited in this context, as some solely focused on specific facets of certain countries, and, on occasion, did not provide pertinent information for the scope of this review.

In addition to scholarly articles, a meticulous examination of official documentation has been undertaken. Every national website pertaining to the subject has been scrutinized, contributing to a holistic understanding of the initiatives, policies, and strategies adopted by each EU member state in the realms of CE and the Just Transition. This multifaceted approach ensures a nuanced and well-rounded exploration of the landscape, taking into account both academic perspectives and the practical implementations and commitments of individual nations within the EU.

22.3 European Circular Economy

To assess the awareness of the CE in the European context, it is imperative to gain insights into how countries are currently implementing and should further enhance their efforts to drive the transition towards the CE. All these reports share a common objective: to expedite the transition of European nations toward the Circular Economy. I have collated and analysed this information to develop a comprehensive framework that both summarizes the progress achieved thus far and identifies potential avenues for enhancement.

In the context of the European Union's policies within the just transition framework, there is a strong emphasis on respecting social aspects, integrated in the just transition European framework. The Just Transition Framework aims to ensure that the transition to a greener and more sustainable economy is fair and inclusive, considering the social dimensions of change. The alignment of social aspects and their adherence to the principles of the Just

Transition Framework is a crucial consideration within the context of this discussion. Several key policies and principles contribute to achieving this goal by means of the following:

- Social Dialogue: Encouraging and facilitating social dialogue is crucial. This involves engaging with workers, employers, and other stakeholders to ensure that the transition is well-managed, and the concerns and needs of all parties are taken into consideration.
- Skills Development: Investing in education and skills development is essential to equip the workforce with the capabilities needed in the evolving economic landscape. This helps workers adapt to new technologies and industries, reducing the risk of job displacement.
- Labor Market Policies: Implementing supportive labour market policies, such as active employment measures and social protection programs, helps mitigate the negative impacts of the transition on vulnerable groups. This includes measures like reskilling programs and unemployment benefits.
- Regional Development: Focusing on regional development ensures that the benefits of the transition are distributed evenly. This involves targeted investments in regions heavily dependent on industries undergoing significant changes, fostering economic diversification and job creation.
- Gender Equality: Promoting gender equality is integral to a just transition. Policies should address potential gender disparities in the workforce and create equal opportunities for men and women in emerging sectors.
- Inclusive Decision-Making: Ensuring that decision-making processes are inclusive and transparent is key. All relevant stakeholders, including local communities, should have a voice in shaping policies related to the transition.
- Social Impact Assessments: Conducting thorough social impact assessments before implementing major changes helps identify potential challenges and allows for the development of tailored solutions to address them.

The transition to CE in EU countries is a multifaceted process involving various initiatives, policies, and collaborative efforts. Listed below are the main programs and initiatives in the European framework:

- EU Circular Economy Action Plan: The European Commission has been a driving force behind the circular economy transition in the EU. The EU Circular Economy Action Plan, introduced in 2020, outlines key initiatives and strategies to advance the circular economy, including sustainable product policies, waste reduction targets, and measures to promote circularity in key sectors.
- Legislation and Regulations: EU member states have been incorporating circular economy principles into their legislation and policies. This includes measures to address single-use plastics, promote recycling, and encourage sustainable product design. Extended Producer Responsibility (EPR) schemes, which make producers responsible for the entire life cycle of their products, have been implemented to incentivize circular practices.
- Waste Management and Recycling: EU countries have set ambitious targets for waste reduction and recycling. The Circular Economy Package includes specific targets for municipal waste recycling, landfill diversion, and reduction of marine litter. Countries are investing in improved waste management infrastructure and practices to achieve these goals.
- Circular Design and Innovation: The EU supports research and innovation in circular design and sustainable technologies. Funding programs, such as Horizon 2020 and its successor Horizon Europe,

provide financial support for projects that contribute to the circular economy, including innovations in materials, manufacturing, and waste management.

- Collaboration and Partnerships: The circular economy transition requires collaboration among governments, businesses, academia, and civil society. EU countries participate in collaborative initiatives and partnerships to share best practices, exchange knowledge, and jointly address challenges related to circularity.
- Consumer Awareness and Education: Raising awareness among consumers about the principles of the circular economy is a key aspect. EU countries are involved in educational initiatives and campaigns to inform the public about sustainable consumption, reuse, and recycling.
- Circular Economy Hubs: Some EU countries have established circular economy hubs or platforms to facilitate networking and knowledge exchange. These hubs bring together stakeholders from various sectors to promote circular practices and innovation. By incorporating these policies and principles into the just transition framework, the EU aims to create an inclusive and socially responsible pathway toward a sustainable and low-carbon economy.

Furthermore, after the Covid-19 crisis, the European Council reached an agreement on July 21st regarding the recovery plan, known as Next Generation EU, in conjunction with the Multiannual Financial Framework (MFF) for 2021-2027. The historic agreement, finalized on December 11th, encompasses a financial package totalling €1.8 trillion. This includes approximately €1.07 trillion allocated to the multiannual financial framework and an additional €750 billion designated for the Next Generation EU (NGEU) recovery instrument. Notably, the NGEU introduces the principle of debt mutualisation, where the European Commission borrows funds on capital markets to finance the recovery instrument.

The agreement places a strong emphasis on environmental sustainability, with a commitment to allocate 30% of MFF and NGEU funds for climate investment. While specific CE objectives are not explicitly outlined, the agreement includes provisions such as a levy on non-recycled plastic packaging waste as a means of generating new own resources. The Recovery and Resilience Facility (RRF) will play a key role, with member states required to present national plans for approval. These plans, evaluated by the European Commission, must align with growth potential, job creation, economic resilience, and the green and digital transition, including a minimum 30% allocation to climate action.

The 'green' transition within these plans encompasses climate and environmental perspectives, necessitating contributions toward achieving 2030 climate and energy targets and the 2050 climate neutrality objective. CE goals are embedded within environmental objectives, urging member states to demonstrate how their plans contribute to sustainable water use, waste prevention, recycling, pollution control, and the greening of urban areas. Investments will need to adhere to EU Taxonomy Regulation criteria, and to the “do no significant harm principle “must underpin all actions.

The assessment of these plans involves a quantitative approach, specifying the degree of impact on climate and environmental objectives. Member states are expected to provide additional assessments of the direct and indirect impacts of proposed reforms or investments. The methodology draws inspiration from the Rio Markers system developed by the OECD. While the European Commission's application of the OECD system has faced criticism, particularly regarding the EU budget, these evaluation methods will influence the distribution of funds under the recovery measures package.

In addition to Next Generation EU, the Multiannual Financial Framework includes InvestEU, designed to allocate funds to specific programmes and measures, emphasizing sustainable investments. The EIB's role in redirecting private investment toward sustainability could significantly contribute to promoting circular economy solutions. Furthermore, initiatives like ReactEU and the extension of the Just Transition Fund will follow established regulations. Next follows a brief overview that will explain all the 27 countries and their contribution to CE transition in their policies and programs.

Austria

Austria boasts a robust CE profile, with a primary focus on environmental innovation, often referred to as "Green Tech" or "Clean Tech." The nation has been making considerable efforts to enhance municipal waste recycling and has shown a commitment to initiatives that facilitate this transition, such as RepaNet. However, for Austria's Circular Economy Strategy to be truly effective, it should incorporate specific objectives aimed at reducing both raw material consumption and waste production. This is especially crucial because Austria ranks among the top waste producers in the region. While the country's National CE plan emphasizes environmental concerns, it tends to overlook the substantial economic opportunities that the CE can provide. Supporting small and medium-sized enterprises (SMEs) and capitalizing on the fact that the service sector contributes significantly to the national GDP, accounting for 63%, could be further strategic actions to be considered in this endeavour. The Austrian government aims to transform the country's economy and society into a sustainable circular economy by 2050, aligning with ecological goals such as achieving climate neutrality by 2040. The circular economy strategy, outlined in the federal program, focuses on interdisciplinary approaches, involving various sectors, regions, and citizens. Given the dynamic and complex nature of the transformation, the strategy emphasizes adaptability and a flexible approach rather than detailed long-term plans. Despite initial successes, Austria acknowledges the need for comprehensive changes in technology, economics, and societal attitudes for the transition to a climate-neutral circular economy. The strategy provides guiding principles, goals, and intervention areas to facilitate concrete measures and activities. The goal is for Austria to become a leading country in this field, and industry participation is crucial for success.

Belgium

Belgium has crafted a comprehensive framework to bolster the CE within the country. Here, numerous initiatives have been set in motion to facilitate a smoother transition. The government has offered subsidies to reduce landfill usage, imposed incineration taxes targeting the reduction of household and small-to-medium enterprise waste, and made substantial investments in robust infrastructure for separate waste collection. These actions underscore the concerted efforts of the government to promote the CE. However, despite these significant steps, Belgium continues to grapple with challenges, including the high operational costs associated with selective waste collection and the need for higher environmental taxation. On March 25, 2016, the Government of Flanders approved Vision 2050, a comprehensive long-term strategy for the region. This strategy envisions Flanders as an open, social, resilient, and international region that combines prosperity and well-being through smart, innovative, and sustainable approaches, ensuring inclusivity. To implement Vision 2050, Circular Flanders (Vlaanderen Circulair) was established in 2017 as a hub and source of inspiration for the CE. Operating as a partnership between the government, private sector, civil organizations, and knowledge institutions, Circular Flanders aims to make Flanders a European circular economy trendsetter by 2030. The government has committed to decoupling the material footprint of Flemish consumption from economic growth and reducing it by 30% by 2030. In 2021, Circular Flanders revamped its governance structure to enhance coordination between the Ministers of Environment and the Economy and Innovation. A Steering Group, comprising 20 core partners representing government, private industry, civil society, knowledge institutes, and the financial world, was established. The Circular Construction Strategic Agenda, led by the Confederation of the Construction Industry and OVAM, outlines six ambitions for 2061 through a co-creation process. The choice of 2061 reflects the typical lifespan of contemporary buildings, lasting for 40 years.To address challenges, stakeholders have identified 10 working paths translated into concrete actions. Some of these actions are already in progress, while others are still being developed.

Bulgaria

Bulgaria currently lags in its adoption of the CE. While the country boasts a low per capita waste production rate, it faces substantial challenges in reducing waste generated by SMEs. Moreover, there is a notable scarcity of available funding for enterprises operating in Bulgaria. To enhance the CE's prospects, it is imperative to concentrate on reducing raw material usage and waste production while also implementing tax incentives to encourage new CE investments. The European Commission has advocated for the promotion of 3Rs practices across all economic activities and the implementation of waste prevention measures. Bulgaria has crafted a draft Strategy and Action Plan for transitioning to a circular economy, set for formal adoption in autumn 2022. The cross-sectoral document leverages measures from various strategies and programs related to the economy, environmental protection, and regional development. The primary aim is to boost resource efficiency by implementing the waste management hierarchy, emphasizing waste prevention, promoting material reuse through recycling, minimizing landfill use, and reducing the environmental and health impact of waste. The draft strategy focuses on three key objectives: fostering a green and competitive economy, reducing waste and optimizing resource use, and creating a consumer-benefiting economy. To achieve these goals, specific measures are outlined in the Strategy and translated into actionable activities in the Action Plan. Implementation of the Plan will address imbalances and overcome obstacles to align with the circular economy strategy. The National Development Programme BULGARIA 2030 is a top-tier strategic framework among national programming documents. It establishes the vision and general goals for development policies across government sectors, including territorial dimensions. The document outlines three strategic goals, grouping government intentions into five development areas and setting 13 national priorities. A first three-year Action Plan for implementing the Programme is currently in preparation.

Croatia

Croatia demonstrates a low per capita waste production, yet faces challenges in recycling municipal waste, risking not meeting European recycling targets. The national Circular Economy plan primarily emphasizes waste management and sustainable tourism. To improve, Croatia should prioritize promoting awareness of Circular Economy transition policies and implementing tax incentives. The European Commission strongly advises both the private and public sectors to incorporate 3Rs practices in their operations and prioritize waste management prevention for enhanced recycling, incineration, and landfill use.

Cyprus

Cyprus, while having below-average per capita waste production, ranks among the top waste producers among the 28 EU Member States. Its national Circular Economy plan predominantly centres around renewable energy sources such as wind and solar power. The country has made substantial investments in resource usage efficiency and energy network infrastructures under the latest framework program (2014-2020). However, its unique geographical location limits multinational corporations' innovative investments, hindering technological advancement. To advance its transition towards a Circular Economy, Cyprus should implement 3R policies aimed at reducing raw material use, municipal waste, and plastics production. Furthermore, investing in research and innovation is crucial to stimulate progress. In 2021, Cyprus adopted its National Action Plan for the Circular Economy 2021-2027. The plan targets key materials and sectors, encompassing the primary, industrial, and service sectors, with waste policy serving as a fundamental and cross-cutting component. It outlines policy measures to facilitate the shift towards a circular economy, aiming to cultivate a circular mindset among industries, businesses, and consumers. The plan also incentivizes businesses to invest in the circular economy, improve circularity, enhance resource efficiency, foster synergies, and create favourable market conditions for circular products and services, ensuring sustainable production and consumption. Specifically, the Action Plan includes programs highlighting business opportunities in the circular economy, financing the development of new circular products and services, boosting investment in circular practices for businesses and the tourism sector, establishing online material sharing platforms, and promoting the development of standards and certifications for systems, products, and services contributing to a circular economy. Additionally, several measures focus on managing waste as a resource, emphasizing increased separate collection of municipal waste to enhance recycling quality.

Czech Republic

The Czech Republic has actively pursued the transition to a Circular Economy and boasts a strong profile in recycling packaging waste compared to the EU28 member states. The country has also received significant EU funding, primarily dedicated to enhancing environmentally friendly innovative technologies and running awareness campaigns aimed at reducing plastic usage. Efforts are underway to address packaging waste issues through the enactment of appropriate legislation. Several initiatives, including the national Waste Management Plan 2015-2024 with a long-term focus on the Circular Economy (Circular Czechia 2040), have been introduced. The country does face challenges in municipal waste management due to the presence of numerous landfills. Additionally, the implementation of EU waste management and plastics regulations has been relatively slow. To further support this transition, it is essential to provide tax incentives for Circular Economy activities, particularly for SMEs. The European Commission strongly recommends both the public and private sectors enhance their 3R actions and incorporate waste prevention practices in their operations. In December 2021, the Czech Republic adopted Circular Czechia 2040, a dedicated national CE strategy. The vision for 2040 is for the circular economy to bring significant environmental, economic, and social benefits to the country, systematically supporting it as a model for improving environmental protection, strengthening competitiveness and technological sophistication, creating jobs, enhancing raw material security, and developing citizens' competencies. The main goal is "Less waste and more value for the Czech Republic," with 10 strategic objectives. These objectives include improving the state of the environment, reducing waste production, enhancing waste management, strengthening competitiveness, creating new jobs, increasing raw material security, improving technological sophistication and innovation, supporting innovative forms of consumption, acquiring new competencies, knowledge, and skills, creating a non-toxic environment, and expanding the circular economy at regional and municipal levels. Circular Czechia 2040 identifies 10 priority areas for the circular economy in the Czech Republic, defining individual goals and measures within each priority. These areas encompass products and design, industry, raw materials, construction, energy, bioeconomics and food, consumption and consumers, waste management, water, research, development and innovation, education and knowledge, economic instruments, and circular cities and infrastructure.

Denmark

Denmark has been a proactive advocate for the transition to a CE from the very beginning. The country holds a leading position in household waste management and has made significant strides in reducing landfills. However, it should be noted that Denmark ranks among the highest per capita producers of municipal waste and has yet to effectively curtail waste production by Small and Medium-sized Enterprises. Denmark has undertaken several initiatives, including the Danish Strategy for Circular Economy, which focuses on providing economic support to activities that aim to recycle materials, reduce waste, and foster environmental innovation. To facilitate this transition, it is essential to improve the coordination of actions at both the national and local levels to ensure consistency and alignment with the EU's waste hierarchy. This can help avoid discrepancies at the municipal level that may not penalize private companies failing to adhere to the established waste management principles. Additionally, the transition can be further accelerated by introducing tax incentives that promote repair services, the circulation of goods, and transactions with clearly defined social objectives. The Action Plan for Circular Economy (July 2021) serves as Denmark's dedicated national strategy and roadmap for the Circular Economy (CE). It also acts as the national plan for waste prevention and management from 2020 to 2032. The plan outlines Danish targets, indicators, policies, and initiatives across the entire circular value chain, spanning from design and consumption to waste, where natural resources are recycled into new products and materials. While addressing various initiatives along the value chain, the Action Plan particularly focuses on three areas with significant environmental and climate impact: biomass, construction, and plastics. It encompasses 129 national initiatives, many of which are currently in implementation. Most of these initiatives are also part of the broader Strategy for Circular Economy (2018), the Action Plan on Plastics (2018), the Climate Plan for a Green Waste Sector and a Circular Economy (2020), the Strategy for Green Public Procurement (2020), and the National Strategy for a Sustainable Built Environment (2021).

Estonia

Estonia is a country with a strong inclination towards the transition to a Circular Economy. The nation has a notably low per capita waste production and has initiated numerous measures to encourage material reuse. It has successfully implemented a deposit-refund system for beverage packaging, leading to the efficient collection of almost the entire quantity of such waste. Estonia's commitment to the CE is exemplified by its establishment of the Institute of Circular Economy and Technology, the first of its kind in the country. This institute, located at TKK University, is dedicated to imparting specific skills essential for supporting the CE transition. Moreover, Estonia has been successful in creating effective national networks that bring together both private and public stakeholders involved in the CE system. These networks facilitate information sharing and constructive dialogues aimed at formulating a national CE strategy. Key players in this endeavour include the Circular Economy Forum, the Estonian Association for Environmental Management, and the Ministry of Environmental Affairs. However, Estonia faces several challenges in its transition policy, such as low resource efficiency, limited engagement of national SMEs in waste reduction practices, and an inefficient system for municipal waste and packaging recycling. Estonia is currently in the process of developing a dedicated circular economy strategy, with plans to release a CE white paper in September 2022, followed by an action catalogue by the end of the same year. The draft of the white paper outlines Estonia's vision for a functioning circular system of production and consumption, positioning the country as a smart leader in the transition to a circular economy by 2030. The goal is to establish a circular and competitive business model through sustainable production, smart technologies, and digital solutions. To realize this vision, Estonia emphasizes the importance of creating a favourable social-economic environment and applying guiding principles, including environmental awareness, cooperation, smart solutions, a systemic approach, and an up-to-date legal environment. The draft document outlines key principles for stakeholders, such as needs-based production and consumption, circular design, employing the best available approaches and technologies, following the materials' hierarchy, and promoting sustainable choices among consumers.

Finland

Finland stands out as one of the European leaders in the transition to a Circular Economy. The country has strategically planned a robust national financing system to drive innovation in the CE through initiatives like the Finnish Innovation Fund Sitra. It has also established programs such as RAKI for the recycling of nutrients and has undertaken various projects focused on plastic reduction and CE, including notable efforts like CIRCWASTE. Finland hosted the World Circular Economy Forum conference, which played a pivotal role in promoting the adoption of best practices and setting essential transition guidelines. The CE transition in Finland has been further catalysed by the widespread awareness within the national community about the opportunities that a CE can offer to both traditional and emerging businesses. Additionally, the government has introduced incentive taxes to encourage recycling and reuse activities. To further strengthen the country's eco-innovation efforts, a particular focus should be placed on harmonizing its legislative framework with the criteria for sustainable forestry outlined by the European Parliament, as well as safeguarding the biological cycle. Finland has two primary Circular Economy strategies: "The Critical Move – Finland's Roadmap to the Circular Economy 2.0" (an updated version of the 2016 roadmap) and the more recent "Strategic Programme to Promote a Circular Economy". The Strategic Programme aims to transform the economy into a circular one based on its principles by 2035. It seeks to strengthen Finland's leadership in the circular economy and contribute to the government's goal of carbon neutrality by 2035. The vision for the CE Programme in 2035 is a carbon-neutral circular society, where sustainable products and services form the economic foundation, the sharing economy is ingrained in daily life, choices bolster a fair welfare society, natural resource use is sustainable, and materials circulate longer and more securely. The breakthrough in circular economy adoption relies on innovation, digital solutions, smart regulation, and responsible involvement from investors, businesses, and consumers. Finland envisions being a global leader and sustainable solutions provider on the international market through the circular economy. To realize this vision, the CE Programme sets objectives, including a decrease in the consumption of non-renewable natural resources, with sustainable use of renewable resources limited to ensure total consumption of primary raw materials in Finland by 2035 does not exceed 2015 levels (excluding resources used for export products).

France

The CE transition in France has led to notable improvements in waste reduction and increased recycling. The country unveiled a national CE roadmap in 2018, featuring effective objectives designed to support this transition. This success can be attributed to the collaborative efforts of the Ministry for an Ecological and Inclusive Transition, the Ministry for the Economy and Finance, and the Institut National de l'Économie Circulaire (INEC). Furthermore, France has implemented a robust legal framework to promote 3R (Reduce, Reuse, Recycle) activities. It has imposed legal sanctions for non-compliance with rules related to collection, recycling, and packaging, especially in the context of plastics. The country has also raised taxes on waste disposal in landfills while reducing taxes on recycling operations. Additionally, social enterprises involved in the collection and sale of used goods receive incentives, including VAT exemptions. Nevertheless, small and medium-sized enterprises would benefit from additional support. Implementing a national program to encourage circular design training could help reduce raw material usage, minimize waste production, and promote practices like reuse, repair, and sharing. In 2018, France adopted a Circular Economy Roadmap, comprising 50 measures categorized into four main priorities: improving consumption, production, waste management, and mobilizing stakeholders. Key objectives include a 30% reduction in natural resource use relative to GDP by 2030, a 50% reduction in non-hazardous waste landfilled by 2025, and aiming for 100% plastic recycling by 2025. The goal is to avoid 8 million tonnes of carbon dioxide emissions annually through plastic recycling and create up to 300,000 additional jobs.

In 2020, the Law Against Waste and for the Circular Economy was enacted to implement these measures, along with additional ones. Measures already in force include the establishment of new extended producer responsibility (EPR) schemes, a repairability index for electronic products, a ban on destroying unsold products, mandatory circular public procurement objectives, restrictions on plastic packaging, and requirements for informing consumers about the environmental characteristics of products. Other measures involve banning single-use plastic products by public authorities, providing information on the carbon footprint of data consumption, and setting minimum availability periods for spare parts for certain products.

Germany

Germany stands at the forefront of the transition towards the Circular Economy and excels in efficiently managing its municipal waste recycling system. The country has implemented a series of well-coordinated CE initiatives, showcasing a strong national-level coordination to enhance resource efficiency and achieve recycling targets. One of Germany's key strengths in the CE realm lies in its promotion of incentives for reuse and design for recycling. This includes measures such as fiscal incentives and a favourable legislative framework. To further encourage recycling practices, Germany introduced a new Packaging Act, complete with a National Packaging Registry. The

German CE plan benefits from a robust national policy framework and a population that is highly aware and receptive to sustainability issues. However, the country faces a significant challenge due to its high per capita waste production, which remains a pressing concern in this context. While not initially designed as a Circular Economy (CE) strategy, the second update of the German Resource Efficiency Programme (ProgRess III), released in June 2020, can be considered as such. The primary objective of ProgRess III is to enhance the sustainability of natural resource extraction and usage, ensuring the long-term preservation of vital natural foundations for future generations. The program outlines measures across the value chain, from raw material extraction to product design, production, consumption, and waste management, focusing on resource efficiency. ProgRess III, with nearly 120 measures and overarching strategies, aligns with all 10 R-strategies of a Circular Economy. Notably, the program concentrates on the material use of abiotic and biotic raw materials, excluding other resources like water, land, soil, and ecosystem services, which are addressed by specific policies and strategies. Similarly, the utilization of fossil and biotic resources for energy generation is covered in various strategies related to Germany's energy transition. ProgRess III aims to close material cycles and underscores the crucial role of product design in achieving these goals.

Greece

The country's performance in both the private and public sectors is notably deficient. The main weaknesses in 3R actions stem from the challenges posed by the linear economy, resulting in a slow response to the proposals put forth by the EU Commission. Despite some efforts to introduce new legislation and allocate funds for educational and organizational purposes, the goals of these measures have been twofold. They seek to enhance knowledge about the Circular Economy while simultaneously improving governance structures through the establishment of a dedicated operational organization aimed at facilitating the transition. It's worth mentioning that these recent efforts align with recommendations from the European Commission. However, they are clearly insufficient to drive a transition from a linear to a circular economy. The European Commission has strongly urged both the private and public sectors to actively promote 3R actions in their activities, enforce waste management prevention practices, implement the National Action Plan on Circular Economy, advocate for transparency laws and regulations, simplify administrative procedures, and embrace Circular Procurement. The Greek Governmental Economic Policy Council approved the National Circular Economy Strategy in December 2018, accompanied by a two-year action plan. The strategy aims to stimulate growth towards a circular economy in alignment with the country's development strategy, focusing on sustainable resource management, support for circular entrepreneurship, and circular consumption. However, due to a lack of tangible results from the initial two-year action plan and considering recent EU developments, including the European Green Deal and the 2020 EU Circular Economy Action Plan, the Hellenic Ministry of Environment and Energy has drafted a new National Circular Economy Action Plan (National CEAP) for the 2021-2025 period. This plan, officially adopted by the Minister's Council Act No 12 on April 29, 2022, aligns with revised national legislation implementing the 2018 EU Circular Economy legislative package. It ensures strong synergies with the 2030 National Waste Management Plan (NWMP) and the recently adopted 2030 National Waste Prevention Programme (NWPP).

Hungary

The shift from a linear to a circular economy in this Member State has been characterized by a sluggish and intermittent progress. Various barriers hinder this transition, notably the absence of widespread resource-efficient and strategic thinking that could facilitate the process. These challenges are pervasive in both the public and private sectors. Within the private sector, both SMEs and large corporations remain firmly entrenched in the linear economy paradigm. In the agricultural and public sectors, no effective plans or actions have been set in motion to support the transition. The European Commission has underscored the significance of taking specific actions to address these challenges. This includes implementing a Hungarian Circular Economy Roadmap, reducing the consumption of raw materials and waste production, increasing activities related to reuse, repair, and sharing (often referred to as 3Rs), safeguarding the environment, and promoting domestic economic growth. In October 2019, the Energy Efficiency Operational Programmes of the Ministry for Innovation and Technology successfully secured EUR 500,000 in funding from the European Commission for the "Introducing Circular Economy and Addressing Waste Management Challenges" project under the Structural Reform Support Programme. Hungary, in collaboration with the Organisation for Economic Co-operation and Development (OECD) as the lead contractor and relevant policy and economic actors, is currently developing a national Circular Economy strategy with a vision statement for 2040. The project, expected to be completed by the end of 2022, focuses on three priority areas with the highest circular potential for Hungary: food/biomass, construction, and plastics. The envisioned statement and objectives are as follows: By 2040, Hungary aims to become a more competitive and sustainable economy, embracing a comprehensive approach to the CE transition that extends beyond waste management to include the industrial, agricultural, and service sectors. All stakeholders will collaborate to achieve the following targets by 2040, compared to 2019 levels: reduce material consumption, close the loop of materials used in the economy, and generate economic value in material-related activities.

Ireland

The Member State has established a robust network for re-use and repair, complemented by various government support programs.

Ireland's CAP Strategic Plan for 2023-2027 is designed to benefit consumers, farm families, and rural communities by supporting the production of safe, sustainable food and contributing to climate and environmental goals.

The CAP is divided into two pillars. Pillar 1 includes direct support through agri-environment schemes and market measures to provide income support and stabilize markets in the face of challenges. This pillar ensures farmers receive support for their land management efforts, maintains farming activities adapted to local conditions, and aligns production with consumer demands. Pillar 2 focuses on rural development, co-financed by EU member states, to modernize farms, enhance competitiveness, protect the environment, and support rural communities. Measures include promoting technology uptake, addressing climate change, encouraging generational renewal in farming, and boosting rural areas through investments. Ireland, as a member state, works closely with the European Commission and the EU Court of Auditors to implement its CAP Strategic Plan, aiming to protect farm incomes, recognize the efforts of farm families, and contribute meaningfully to climate goals. The plan emphasizes sustainable agriculture, viability, and the vitality of rural communities. Nevertheless, the impact of these initiatives has been more pronounced within the public sector, with less substantial results observed in the private sector.

Notably, small, and medium-sized enterprises and large corporations have struggled to enhance the efficiency of the 3R strategy. The European Commission emphasizes the significance of executing a Green Deal Circular Procurement and the advancement of an Irish Circular Economy Roadmap. Ireland has undergone significant policy and legislative initiatives to transition to a circular economy, as highlighted in the OECD's 2022 report on The Circular Economy in Ireland. The country is deemed to be at a crucial turning point in this transition. Several key developments include the publication of a new waste policy, "A Waste Action Plan for a Circular Economy," in September 2020. In December 2021, Ireland introduced its first national Whole of Government Circular Economy Strategy. Subsequently, the Circular Economy and Miscellaneous Provisions Act 2022, known as the Circular Economy Act 2022, was published in July 2022. The National Waste Prevention Programme has been transformed into a national Circular Economy Programme, published in December 2021, and the new National Waste Management Plan is being drafted with a focus on a Circular Economy. The National Hazardous Waste Management Plan 2021–2027 has also been realigned to support and deliver a circular economy. The Waste Action Plan for a Circular Economy shifts the focus from waste disposal to preserving resources through circular economic practices, outlining aims, targets, and corresponding measures for the State. The Whole of Government Circular Economy Strategy 2022–2023 is Ireland's inaugural national strategy for the circular economy, emphasizing an overarching policy vision and approach.

Italy has undertaken a comprehensive approach to embrace a CE, positioning it as a cornerstone in its strategic development. The National CE Strategy serves as a guiding framework, steering the country's shift from a linear to a circular economic model. This overarching strategy encompasses measures designed to enhance resource efficiency, reduce waste, and promote sustainable production and consumption practices. In parallel, Italy has enacted legislative measures and policies geared towards propelling the circular economy forward. A pivotal aspect of Italy's CE endeavours is its concerted focus on waste management. The nation has implemented initiatives to revamp waste collection systems, elevate recycling infrastructure, and champion waste-to-energy projects. The overarching goal is to minimize reliance on landfills and facilitate the recovery of materials from waste streams. In tandem with these efforts, Italy is channelling investments into research and innovation, funding is directed towards projects exploring sustainable technologies, circular design principles, and innovations in waste management methodologies. Businesses in key sectors, such as fashion and manufacturing, are actively embracing circular economy principles in Italy. Initiatives within these sectors focus on waste reduction, material reuse, and the implementation of sustainable production methods. The Ministry of Ecological Transition adopted the National Circular Economy Strategy in June 2022 as part of Italy's Recovery and Resilience Plan. The strategy, under Mission 2, Component 1, focuses on key milestones tied to loan payments, including a new digital waste traceability system, tax incentives for recycling and secondary raw material use, revised environmental taxation on waste, the right to reuse and repair, and reforms to extended producer responsibility (EPR) and Consortia systems. It also supports existing regulatory tools like end-of-waste legislation, minimum environmental criteria for green public procurement (GPP) in construction, textiles, plastics, and waste electrical and electronic equipment (WEEE), along with backing industrial symbiosis projects. The overarching targets for 2035 include developing secondary markets for raw materials, reforming EPR and Consortia systems, creating a favourable fiscal system for a circular economy, strengthening upstream circularity strategies like eco-design and product lifespan extension, adopting methodologies to quantify environmental impacts, and integrating circular economy issues into school curricula and professional training.

Latvia

Latvia's progress in the CE field has been rather unsatisfactory, primarily due to issues in waste management. The main challenges relate to the inadequate collection and sorting of materials, as well as the limited economic value generated from recycling efforts. Furthermore, there is a noticeable lack of awareness among stakeholders regarding the necessity of transitioning to a circular economy. Recommendations from the European Commission revolve around the 3R strategy, which encompasses waste reduction, material reuse, and recycling. Specifically, these suggestions emphasize the utilization of EU funding to enhance waste management infrastructure while promoting consistent regulations at both national and local levels. Additionally, they propose the adoption of the Green Deal for Circular Procurement, targeting both the public and private sectors, along with the inclusion of a free training program. Latvia introduced a CE strategy, the Action Plan for the transition to a circular economy 2020–2027, in 2020. The plan aims to establish a policy framework fostering Latvia's transition to a CE while aligning with the European Green Deal and UN Sustainable Development Goals. The Action Plan focuses on prudent implementation of the CE in Latvia, promoting thoughtful resource planning, utilization, and sustainable production and consumption across sectors.

Lithuania

Lithuania has made significant progress within the private sector, where both SMEs and larger companies have undertaken strategic initiatives aimed at aligning with the circular economy's principles. Their actions are geared towards meeting market demands and addressing environmental concerns, thereby facilitating the transition. However, the situation is quite distinct within the public sector. Here, there is a pressing need for more substantial efforts, marked by the absence of effective policy measures promoting the transition and limited government engagement at both the national and local levels. These challenges continue to impede CE advancements. The European Commission has put forth several recommendations to address these issues. These suggestions encompass the following actions: redirecting investment cash flows from incineration towards more sustainable options, implementing taxes on landfill usage, and enforcing EU regulations on waste management and plastics within the next two years. Furthermore, the EU Commission has advised pursuing additional EU funding to establish a national support program for promoting economic growth within the public sector. This program should focus on targeted activities designed to foster the creation of a CE hub. Lithuania is increasingly prioritizing the transition to a CE to achieve climate neutrality and sustainable development goals while ensuring economic growth and environmental safety. A working group has been established to formulate the National Action Plan for the Circular Economy covering 2023–2035, with the draft set for completion in October 2022. This plan will address circularity in various sectors, including industry, bioeconomy, transport, construction, consumption, and new business models. The shift to a CE necessitates a new approach to raw material use and product consumption, emphasizing the widespread adoption of eco-design to create high-quality, easily repairable, and recyclable products. Despite these efforts, Lithuania's circular material use rate is currently low at around 4.4%, significantly below the EU average of nearly 13%. Lithuania's key objectives for the waste sector include expanding the separate collection of biowaste, textile waste, and furniture waste, providing financial support for innovation and recycling, implementing recycling taxologies, and increasing the use of secondary raw materials to align with the EU average.

The completed roadmap for Lithuania's industrial transition to a circular economy will serve as the foundation for the upcoming National Action Plan.

Luxemburg

Luxembourg adopted a national Circular Economy (CE) strategy in February 2021, and it has been made available on the CE portal. This strategy serves as a practical guide for public authorities to implement circular practices within specific sectors falling under their jurisdiction, including construction, education and training, finance, food and biomaterials, industry, and retail. The strategy outlines general tools for public authorities to activate and align within their respective sectors, encompassing regulation and standards, financial aspects, and knowledge creation and management. A co-creation approach is employed, encouraging collaboration with relevant public and private stakeholders. To ensure tangible impacts, roadmaps will be developed for each sector, setting meaningful objectives and indicators. The strategy's key goals involve aligning national initiatives and establishing an information and coordination platform. This platform involves collaboration among five national ministries: energy and spatial planning, economy, environment, climate and sustainable development, finance, and labour, employment, and the social and solidarity economy. The implementation of concrete projects is delegated to various national agencies, working in partnership with industry or municipalities.

Malta

Malta has experienced an exceptionally sluggish pace of progress, primarily attributable to a range of natural barriers. These obstacles include a heavy reliance on external energy sources, limited access to natural resources, and delays in the innovation process within the private sector. To address these challenges, the European Commission has offered a series of systemic actions as recommendations. These proposed actions encompass the implementation of EU regulations concerning waste management and plastics within the next two years. Additionally, the Commission suggests initiating a Green Deal focused on Circular Procurement, which is intended to encompass both the public and private sectors. Complementing these measures is the introduction of a free training program aimed at facilitating the transition towards a circular economy. Malta has introduced a Circular Economy Strategic Vision, titled "Towards a Circular Economy 2020–2030." This vision aligns with the government's commitment to constructing the nation's inaugural waste-to-energy facility and its ongoing initiatives to diminish landfill use. The goal is to cultivate an environment conducive to a sustainable, low-carbon, resource-efficient, and competitive economy, aligning with the EU Commission's Circular Economy Strategy. The initial emphasis has been on implementing Action 3, with plans for commencement soon. The overarching regulatory framework is primarily governed by S.L. 549.134 Beverage Containers Recycling Regulations. These regulations aim to boost the circular economy by establishing a beverage-container refund scheme, enhancing the collection and recycling of beverage containers, increasing national recycling endeavours, and reducing litter. It's noteworthy that these regulations do not exempt producers placing beverages in containers on the market from their obligations under S.L. 549.43 Waste Management (Packaging and Packaging Waste) Regulations for any beverages, beverage containers, or other packaging not covered by these specific regulations.

The Netherlands

This Member State stands out as a pioneering force in Europe's transition towards a CE. The systemic actions and initiatives the country has undertaken have solidified its position as a leader in driving this transition. The Netherlands has introduced an array of comprehensive roadmaps, strategies, and programs involving both the private and public sectors. This approach has engaged all relevant stakeholders in a collective effort to promote the transition. Despite its impressive progress, the European Commission has recommended further measures to support the CE's continued growth within the country. These recommendations include establishing a long-term budget dedicated to sustaining the Circular Economy, primarily funded by domestic resources. The Commission also encourages fostering cross-sectoral collaboration and nurturing the development of new circular value chains. The primary objectives encompass achieving a 50% reduction in raw material consumption by 2030 and establishing a circular economy in the Netherlands by 2050. The comprehensive government program, "A Circular Economy in the Netherlands by 2050," was introduced to the House of Representatives on September 14, 2016. This program outlines the necessary steps to utilize raw materials, products, and services more efficiently and intelligently, aiming to realize the circular ambition by 2050. By 2030, the consumption of primary abiotic raw materials should be halved, and the Dutch government has articulated three key goals to expedite the circular transition of the economy: Enhancing the efficiency of production processes to reduce the need for raw materials. Utilizing sustainably produced renewable raw materials, such as biomass, to diminish dependence on fossil fuels and benefit the environment. Developing new production methods and designing products with circularity in mind. These national goals align with international commitments, including EU circular economy policy, the UN 2030 Sustainable Development Goals (SDGs), and the Paris Agreement on climate. The Dutch government's circular economy webpage includes a timeline for the transition towards 2050 and relevant policy documents published until the end of 2021. Implemented initiatives include the 2017 Raw Materials Agreement, involving over 400 parties from government and industry, outlining steps for the Dutch economy to run on renewable resources. In 2018, five transition agendas were formulated for sectors like plastics, consumer goods, manufacturing, construction, and biomass and food, focusing on achieving circularity by 2050. The webpage "Accelerating the transition to a circular economy" describes these transition agendas.

In 2019, the Dutch government presented the Circular Economy Implementation Programme, translating the five transition agendas into concrete actions and projects to be implemented between 2019 and 2023.

Poland

Poland is a Member State that currently has a relatively low focus on the CE. Several factors contribute to this situation, primarily stemming from the public sector's limited responsiveness to the transition. Additionally, the agricultural and manufacturing sectors face significant technological gaps in their adoption of circular practices. Considering these challenges, the European Commission has proposed a set of recommendations designed to propel Poland's CE efforts forward. These suggestions include implementing the Polish CE roadmap, reducing raw material consumption, curbing waste production through the principles of the 3Rs (reduce, reuse, recycle), optimizing resource utilization, and ultimately achieving full circularity within the next decade. These actions are aimed at promoting and accelerating the country's transition to a CE. In 2019, the Council of Ministers approved the Circular Economy Roadmap developed by the Ministry of Economic Development and Technology. The roadmap focuses on various tools, not limited to legislation, to facilitate the transition to a circular economic model in Poland. It encompasses activities related to sustainable industrial production, consumption, bioeconomy, new business models, and the implementation and monitoring of the circular economy. The roadmap, spanning until 2023, involves over 40 tasks assigned to specific ministries. The Ministry of Economic Development and Technology, for instance, is engaged in activities such as conducting a feasibility study on a platform for secondary raw materials, developing a government information platform on circular economy, conceptualizing a support ecosystem for enterprises based on circular economy business models, establishing the National Smart Specialisation for the circular economy, and implementing the This-is-CE (oto-GOZ) project, which aims to assess the progress and impact of the circular economy in Poland. The roadmap serves the overall development of the circular economy, with tangible benefits reported by the responsible ministries.

Portugal

Portugal has demonstrated a commendable commitment to a CE agenda within the public sector. This focus is evident in efforts aimed at reducing and reusing materials to enhance service delivery. Notably, these principles have been extended to include immaterial resources, such as the reuse of software within public administrations. However, while the public sector exhibits strength in these areas, the private sector presents a different picture. Within the private sector, both small and large companies have made progress in improving their CE performance. Nevertheless, numerous challenges persist. Local waste recycling and material reuse practices within the private sector remain notably inefficient, and the 3R strategy's implementation is rather weak. Recognizing these challenges, the European Commission has provided specific short-term recommendations. These recommendations emphasize the need for intensified measures to protect the environment and the establishment of a legislative framework to ensure compliance. These actions are strategically aimed at supporting the economic growth of local companies and facilitating the transition from a linear to a circular economy. The Portuguese National Action Plan for the Circular Economy (PAEC), adopted in December 2017 and implemented from 2018 to 2020, is currently undergoing revision to address new circular economy challenges. The PAEC aims to propel Portugal towards its 2050 ambition, focusing on carbon neutrality, resource efficiency, knowledge advancement, inclusive economic prosperity, and a flourishing society. The plan operates at national, sectoral, and regional levels, aligning with EU Circular Economy Action Plan pillars and targeting specific areas such as design, market, education, food waste, and research and innovation. Sectoral focus includes resource-intensive industries like construction, textiles, tourism, and consumer goods. Regional agendas for the circular economy have been developed to adapt national objectives to regional contexts, fostering collaboration and coordination.

Romania

Romania faces considerable challenges in its pursuit of improved CE performance. The country lags other Member States in both the private and public sectors at both the national and local levels. This delay is evident at all levels and is exacerbated by the fragmented and uncoordinated nature of the measures taken thus far. To drive improvements, a shift towards a 3R approach is essential. This approach should involve the development of new products crafted from reused or recycled materials, as well as the promotion of reusable products. In this context, the European Commission has put forth specific recommendations for both the private and public sectors. These recommendations are focused on actions that address environmental concerns and the establishment of a comprehensive legislative framework to guide and support CE initiatives. Romania recently approved the National Strategy for the CE through Government Decision no. 1172/21 September 2022. Developed in collaboration with key ministries, this strategy aims to guide the transition from a linear to a circular economic model. It focuses on 14 economic sectors, highlighting seven with the highest circularity potential: agriculture, automotive, construction, consumer goods (food and beverages, packaging, textiles), and electrical and electronic equipment. The primary objective is to establish a framework for circular economy transition through an Action Plan. The success metric is the decoupling of economic development from natural resource use and environmental degradation. Aligned with UN Sustainable Development Goals, global climate objectives, and the EU Circular Economy Action Plan, this strategy integrates with Romania's National Strategy for Sustainable Development 2030 and the National Recovery and Resilience Plan. A joint inter-ministerial coordination process, led by the Head of the Chancellery of the Prime Minister, will adapt the strategy to national specifics and global trends. This collaborative approach involves key stakeholders for effective implementation. The timeline foresees the adoption of the Circular Economy Strategy and Action Plan by 2023, with an Action Plan in place by the third quarter of 2023, ensuring Romania's transition by 2030.

Slovakia

Despite increased efforts, Slovakia has made minimal progress in its transition towards a CE. Inefficient municipal waste management practices, coupled with delays in implementing CE principles, have contributed to these limited results. To expedite the CE transition, the European Commission has recommended several key actions. First, the launch of a Green Deal Circular Procurement initiative is crucial for both the public and private sectors. Additionally, the initiation of free training programs can help build necessary skills and knowledge. Ensuring compliance with EU regulations on waste management and plastics within the next two years is also imperative. One strategic objective to achieve is a reduction in per capita municipal waste production in both the public and private sectors. These measures are essential for supporting the transition from a linear to a circular economy. Slovakia has undertaken a project aligned with the Organisation for Economic Co-operation and Development (OECD) and the European Commission Roadmap for Circular Economy in the Slovak Republic. The roadmap concentrates on three primary focus areas: promoting sustainable consumption and production, particularly through economic instruments; exploring circular economy potential within the construction sector; and working towards circularity in the food and bio-waste value chain. The policy measures identified in these areas aim to boost the utilization of secondary raw materials, encourage eco-design and eco-innovation, promote circular consumption patterns, and enhance waste management, reuse, and recycling.

Slovenia

Slovenia has undertaken numerous initiatives with the aim of achieving circularity, but many of them have not been successful. This is primarily due to the lack of improvements in waste management and a production system that remains rooted in the linear economy. In response to these challenges, the European Commission has provided critical recommendations. They emphasize the strategic importance of implementing a Green Deal on Circular Procurement for both the public and private sectors, accompanied by the establishment of a free training program.

Furthermore, the EU Commission advises reducing the use of raw materials and minimizing waste production. To address these recommendations effectively, Slovenia must put in more effort to promote the use of secondary raw materials and establish a suitable materials accounting system. These actions are essential for achieving circularity objectives within ten years, in compliance with EU recommendations. In 2018, the Slovenian government introduced the Roadmap toward a Circular Economy as an ongoing process rather than a conclusive document. This strategic initiative aims to provide guidelines for Slovenia, ensuring a systematic and controlled transition to a CE. While primarily directed at the Slovenian government, the roadmap also extends its focus to all stakeholders who have played crucial roles in its development. These stakeholders, as co-creators, bring valuable insights and examples of good practices that may otherwise go unnoticed or unsupported. The roadmap seeks to achieve several goals: Outline the potential for Slovenia to lead the transition to a CE in Central and Eastern Europe. Engage stakeholders in identifying and connecting circular practices. Provide recommendations to the government to facilitate a more efficient transition. Identify circular opportunities that enhance Slovenia's international economic competitiveness and improve the quality of life for its citizens.

Recognized priority areas within the roadmap include the food system, forest-based value chains, manufacturing industry, and mobility.

Spain

Spain is making significant strides in the transition to a CE in both the private and public sectors. Notably, the private sector, encompassing SMEs and large corporations, is demonstrating substantial progress in promoting employment development and resource efficiency through the advancement of the reuse process. However, there are still areas that require attention, such as increasing the recycling of municipal waste and fostering greater stakeholder engagement. In response to these challenges and opportunities, the European Commission has put forth essential recommendations. These recommendations include the swift implementation of the new EU regulations concerning waste management and plastics within the next two years. Furthermore, Spain should enhance its Circular Economy Roadmap and focus on reducing raw materials use and waste production to further bolster its CE initiatives.

In June 2020, Spain approved the Circular Economy Strategy (España Circular 2030), aiming to establish a new production and consumption model. This strategy focuses on maintaining the value of products, materials, and resources within the economy for as long as possible, minimizing waste, and maximizing reuse. España Circular 2030 aligns with EU Circular Economy Action Plans, the European Green Deal, and the UN 2030 Agenda for Sustainable Development. The strategy outlines goals for 2030, including reducing material consumption, waste, and greenhouse gas emissions, promoting reuse, and improving water use efficiency. The Circular Economy Action Plan I, adopted in 2021, allocates a budget of EUR 1,529.47 million for 116 measures. These measures, grouped into five axes and three action lines, address production, consumption, waste management, secondary raw materials, and water purification and reuse. Specific initiatives include promoting eco-design, enhancing product labeling, improving waste hierarchy practices, supporting water purification and reuse, and fostering research, innovation, and competitiveness. The Action Plan aims to achieve the outlined objectives by 2030, with mid-term assessments underway for the 116 measures.

Sweden

Sweden has showcased an impressive commitment to implementing a CE. The country has deployed numerous strategies to effectively realize CE objectives. Particularly within the private sector, both SMEs and large corporations have adopted proactive behaviours to swiftly achieve the goals outlined by the national government and the European Union. It is noteworthy, however, that this proactive attitude in the private sector is not mirrored in the public sector. While specific objectives have been achieved in the public sector, both at the local and central levels, a systemic transformation in public administration has yet to materialize. A few examples of commendable practices within the private sector include the application of a reduced VAT rate and income tax reductions for certain repair services. Following the recommendations of the European Commission, these actions have the potential to cultivate a collective ambition to shift from a linear economy to a circular one. Sweden adopted a National Strategy for CE in July 2020, followed by a CE action plan and an Action Plan for Plastics. Aligned with environmental, climate, and Sustainable Development Goals, the vision is an efficient, non-toxic circular flow of resources. Four focus areas include better product design, sustainable consumption, non-toxic material cycles, and incentives for circular transition. Six prioritized material streams are plastic, textiles, food, renewable materials, construction, and critical metals. The Action Plan, linked to the CE strategy, comprises over 100 measures targeting production, consumption, hazardous substances, and innovation. Notable actions include establishing a national platform for sustainable fashion, coordinating efforts for sustainable plastic use, enhancing non-toxic product design, and funding research for circular business models. A separate Action Plan for Plastics has been published. National Waste Management Plan and Waste Prevention Programme are also in place. Sweden's Action Plan for Sustainable Regional Development (2022–2024) focuses on smart specialization and fostering a competitive, circular, and bio-based economy. It emphasizes regional cooperation, knowledge sharing, and supporting small and medium-sized enterprises in their circular transformation.

22.4 Discussion

EU countries share several similarities in their approaches to circular economy initiatives. While individual countries may have unique strategies, there are common themes and practices that reflect the collaborative and integrated nature of EU policies. Here are some key similarities/commonalities:

- EU Circular Economy Action Plan: EU countries align with the EU Circular Economy Action Plan, which provides a comprehensive framework for promoting a circular economy. The plan includes initiatives to improve resource efficiency, reduce waste, and foster sustainable production and consumption practices. Waste Management and Recycling Targets: EU member states adhere to common waste management and recycling targets set by the EU. These targets aim to reduce landfilling, increase recycling rates, and promote the sustainable management of waste streams.
- Product Design and Extended Producer Responsibility: Countries in the EU focus on promoting eco-design principles to enhance the recyclability and durability of products. Many countries also implement Extended Producer Responsibility schemes, holding manufacturers accountable for the entire life cycle of their products.

- Plastic Waste Reduction: There is a shared commitment to reducing plastic waste. EU countries are working towards the implementation of measures such as single-use plastic bags, promoting alternatives, and increasing recycling of plastic materials.
- Circular Procurement: EU countries emphasize circular procurement practices to encourage the purchase of goods and services with a lower environmental impact. This involves considering the life cycle of products in public procurement decisions.
- Innovation and Research: A common focus on research and innovation to support the CE is evident. Countries collaborate on projects and share best practices to accelerate the development and adoption of innovative technologies and processes.
- Awareness and Education: EU countries recognize the importance of raising public awareness and promoting education about the principles of the CE. Initiatives include campaigns to inform citizens about waste reduction, recycling, and sustainable consumption.
- Collaboration and Knowledge Exchange: Collaboration and knowledge exchange between EU countries play a crucial role. Platforms, networks, and forums facilitate the sharing of experiences, challenges, and successful strategies in implementing circular economy initiatives.
- Legislation and Policy Alignment: The regulatory frameworks of EU countries are often aligned to comply with overarching EU legislation related to the circular economy. This ensures a consistent and harmonized approach across member states.
- Circular Economy Stakeholder Engagement: Governments, businesses, NGOs, and other stakeholders actively engage in dialogues and partnerships to promote the circular economy. This collaborative approach helps address challenges and create synergies for sustainable development.

While each EU country tailors its CE initiatives to its specific context, these commonalities reflect the shared commitment to advancing a CE agenda across the European Union. Considering the prevailing social and economic conditions in EU countries and the state of our natural environment, the transition to a Circular Economy appears not only essential but imperative. With a growing global population, the availability of raw materials worldwide is becoming increasingly limited, emphasizing the urgency of shifting our focus towards recycling and proactively preventing waste generation. The European Union holds a pivotal role in propagating the CE concept. It has released numerous CE-related documents and mandated its member states to engage in the processes necessary for transitioning their economies toward a CE model. Essential for the successful implementation of CE are the measurement and evaluation of the actions taken. This includes monitoring the progress of the transformation towards a CE, as well as assessing the effectiveness of CE objectives at multiple levels, such as macro, meso, and micro levels.

The varying levels of progress among individual countries in their transition to the CE can be attributed to several factors. These include the adoption of different development strategies aimed at shifting their economies toward a circular model, as recommended by EU ministers at the Environment Council in June 2016. Furthermore, disparities in social and economic development, notably between the EU-15 and the EU-13 countries, play a significant role. Regrettably, the outcomes achieved thus far suggest that only a limited number of these development strategies can be deemed effective in aligning with the circular economy standards set by the European Union and in some countries.

In summary, the European Union's progress towards adopting a circular economy has been remarkably sluggish. From 2015 to 2021, the collective circularity rate of all 27 EU member countries only increased by a meagre 0.4

percentage points. Disconcertingly, seven countries, namely Lithuania, Sweden, Romania, Denmark, Luxembourg, Finland, and Poland, regressed during this period. Consequently, auditors have cast doubt on the EU's ambition to double its proportion of recycled materials integrated back into the economy by 2030, deeming it a formidable challenge.

A circular economy aims to maximize the value of products, materials, and resources by minimizing waste. To facilitate this transition, the European Commission introduced two Circular Economy Action Plans. The initial plan, launched in 2015, included 54 specific actions, while the second plan, released in 2020, added 35 new actions and set the target of doubling the "circularity rate" by 2030 – the proportion of materials recycled and reintegrated into the EU economy. These plans are not legally binding but were designed to assist member states in boosting circular economy initiatives in recent years. By June 2022, nearly all EU countries had either adopted a national circular economy strategy or were in the process of developing one. To support the transition, the EU allocated over €10 billion between 2016 and 2020 for green innovation and aiding businesses in embracing the circular economy concept. However, member states predominantly spent this funding on waste management rather than preventing waste through circular design, a strategy that likely would have had a more substantial impact. While the latter strategy could potentially yield a more significant impact, it is not the primary emphasis within the framework of the just transition in the CE. While the EU action plans did incorporate several initiatives aimed at promoting innovation and investment, there is still a substantial distance to cover in this regard.

22.5 Conclusions

The CE model represents a departure from the prevalent linear economic model, characterized by the "take, make, consume, dispose" approach. It advocates for closing the loop, replacing the "dispose" stage with "reuse." The principles of the CE are applicable throughout a product's lifecycle, spanning design, production, consumption, and waste management. Various legislative acts, guidelines, and financing programs support the implementation of CE principles. The transition to a CE can occur at macro, meso, and micro levels, necessitating considerable time and investment. The European Union plays a pivotal role in promoting CE principles, as evident in documents from the European Commission mandating member states to undergo processes for transforming their economies. These documents emphasize monitoring CE progress through a designated framework, enabling comparisons between member states and facilitating the sharing of best practices. The analysis reveals that older EU member states (EU-14), particularly Germany, Belgium, the Netherlands, Spain, France, Italy, are more advanced in CE. Conversely, Malta, Cyprus, Croatia, Latvia, Ireland, and Greece exhibit lower CE advancement. Belgium and the Netherlands show significant upward trends in encouraging CE. Germany emerged as the most advanced in CE transformation, while the least advanced included Cyprus, Czechia, Malta, Lithuania, Latvia, Hungary, Ireland, Slovakia, Romania, Estonia, Croatia, and Bulgaria.

The varied CE progress across countries stems from differences in adopted development strategies, socio-economic disparities between EU-14 and EU-13 countries, and the effectiveness of implemented strategies. The study acknowledges certain limitations, including the existence of websites in multiple languages and variations in the articles found concerning advancements in the field of the circular economy. These factors contribute to the complexity of the analysis and may introduce nuances in the interpretation of the progress observed. As already said, the European Union plays a pivotal role in disseminating the CE concept, publishing numerous CE-related documents and obliging its member states to undergo processes associated with transitioning their economies to a circular model. Effectively measuring and assessing activities undertaken to implement CE is crucial for its proper execution. Monitoring should extend to the progress of transformation towards CE and the efficiency of achieving CE goals at various levels, including macro, meso, and micro levels. The European Commission, in its commitment to advancing the Circular Economy, has devised a monitoring framework that undergoes continuous refinement. European countries, in a broader context, assume a pivotal role in this sector's development. However, it is imperative to acknowledge that there is still progresses to be made, particularly concerning aspects related to the concept of a just transition. Achieving a more comprehensive and inclusive circular economy requires further steps, with an emphasis on addressing social and economic justice considerations within the overarching framework of sustainable development.

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Chapter 23. Circular Economy transition in China ed India

Antonio Thomas

Abstract

China and India are the world's two most populous countries, characterized by various similarities, such as an export-driven economy. Nevertheless, they seem to have approached the topic of circular economy and sustainability more broadly somewhat differently.
The investigations conducted by Chinese and Indian researchers show a different approach toward the topic of circular economy. For China, government action appears to be very incisive, maybe in the attempt to maintain world leadership as the leading exporting country. For India, on the other hand, the country's difficulty in countering the rapid population growth that has occurred in the last decades and the corresponding growth in waste, as well as tackling the environmental and social impacts, emerges. Some remarks can be derived from this comparison, which in some way is still conditioned by the presence of a different amount of resources to be invested in this direction.

Keywords: circular economy, sustainability, municipal solid waste, 3R principles, eco-industrial parks.

The paper aims to underline how two large countries with many similarities demonstrate different attention toward circular economy and sustainability in general. A significant issue by virtue of their high impact on the environmental sustainability of the entire planet.

A bit odd phrasing, and definitely too vague

23.1 Introduction

The circular economy is gradually changing how we manage and use the resources and materials needed to carry out human and industrial activities. The most significant change is probably, at the cultural level related to an increasingly pervasive diffusion, in the international community, of the logic underlying sustainable development. Pivotal to this approach is the need to re-use, repair or remanufacture products that are commonly used in production processes, with a potential 48 percent reduction in greenhouse emissions by 2030 (EllenMacArthurFoundation, 2015). More and more countries and companies, therefore, have decided to change production methods to adopt circular economy practices; starting with the use of materials and production processes that can facilitate the recovery of used materials.

Not by chance, the concept of circular economy (hereafter CE) has recently gained momentum in the political, scientific, and economic debate. As a result, organizations and scholars have established different sets of principles for its adoption, also widening the perspectives linked to the implementation of CE pillars to those technical, geopolitical and social factors able to assure a transition to the CE that also becomes responsible, inclusive and socially fair for people living in heterogeneous contexts characterized by specific different features.

The attention paid by the European Union (EU) in this regard is certainly to be judged as a pathfinder. In 2020, as part of the *European Green deal*, the European Commission adopted a set of proposals to make the EU's climate, energy, transport, and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990. This target includes specific regulations, such as new rules on packaging, the abolition of planned obsolescence of products, and the 'right to repair, to extend the life cycle of products, minimizing waste, and recycling materials to make them participate in other production cycles. The latter goals aspire to combine sustainability with an increase in the competitiveness of EU countries and employment dynamics.

Of course, the EU is not the only significant area of the world that is quickly heads toward the CE path. International objectives for achieving a global CE are enclosed in the United Nations' *Sustainable Development Goals* (SDGs) signed by all 191 UN Member States. Specifically, Global Goal 12 aspires to ensure sustainable consumption and production patterns. It includes targets that intend to achieve more efficient use of resources (target 12.2) and reduce waste generation through prevention, reduction, recycling, and re-use (target 12.5).

Less known could be the directions in which other areas of the world are moving. In this regard, this chapter aims to provide an overview of the state of the art of EC-related practices adopted in China and India. The aim is to show and discuss the main policies that these two great nations have implemented in the direction of sustainable development.

The salient characteristic of China and India is that their fast-growing economies are expected to dominate the global economy by 2050. Geographically, these two countries cover a combined area of 12,857,460 km^2, about 8.7% of the world's land surface, with an estimated total population of about 2,86 billion, 35.6% of the global population. Economically, they are members of the G20, with a combined total GDP of around US$ 20,648 trillion (21.9% of global GDP), and a GDP pro-capita of US$ (PPA) 21,358 and 8,358, respectively (FMI database).

The next two sections describe the development and the key features of CE in China and India. The last section offers some conclusive remarks.

23.2The development of circular economy in China

23.2.1 The framework

People's Republic of China has a long and established tradition of policies related to the CE, as in this country, CE is not simply regarded as an incrementally improved environment management policy, but it has been introduced as a binding paradigm supporting the transition of the country's economic system toward a more sustainable economic structure. Consistently, the CE embodies a broad series of environmental efficiency-oriented initiatives concerning the whole material flow at all production, distribution, and consumption (Su et al., 2013). In doing so, the CE traditionally covers more areas, aside from resources and waste problems, concerning renewable energy systems and energy saving, land management and soil protection, and water resource management (Geng and Doberstein, 2008). Consistently with these assumptions, in this country, CE is usually meant as "a generic term for the reducing, re-using and recycling activities conducted in the process of production, circulation, and consumption", reflecting the linkage with the "3R framework" (reduce, re-use, recycle) (Liu et al., 2017).[38]

Not surprisingly, policies regarding a comprehensive resource utilization were first introduced in the 1950s, hoping to obtain more products from the same resource (Zhu et al., 2010). In the 1970s, the attention to sustainability issues significantly increased because of the effects of growing pollution and the enormous demand for resources caused by the rapid industrialization processes involving the country. Until the 1990s, however, the main reason that prompted the interest in the EC principles was the lack of resources that could feed an economy with an average growth of 10.6% per annum during the last 30 years. The search for more efficient methods of using resources or for their re-use has, therefore, become a fundamental goal for the largest worldly exporter and energy user (21.3% of the total in the world).

The rapid growth of the economy has also caused extremely serious problems in the country, such as air pollution, deforestation, water depletion, desertification, land degradation, loss of biodiversity. Consequently, China's politicians have been encouraged to consider the EC as a pathway to follow in order to reduce the exponential increase of greenhouse emissions and environmental degradation, ensure human health, and to contrast the other social problems due to the huge population, such as pollution by urban and industrial waste.

However, only from 2002, the concept of CE formally found its introduction in China, when the Government accepted the idea of a new development strategy entrusted to an entity named *State Environmental Protection Administration*. In that year central authorities also enacted the *Cleaner Production Promotion Act*.

In the meantime, in 2004, China became the world's largest waste generator overtaking the USA. This immense amount of industrial solid waste produced by the Country represents one-quarter of the world total (Geng and Doberstein, 2008). Moreover, China also consumes approximately 2.5 kilograms of raw material to produce $1

[38] The Chinese approach toward CE is wider than that proposed both by the *EllenMacArthurFoundation*, and the EU. The first considers the CE an alternative form of economic model that aims at decoupling global economic development from finite resource consumption (2015: 20): "one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles". The EU concept of CE focuses on the value of products and resources, and aims at promoting the minimization of their use and waste: "the value of products and materials is maintained for as long as possible; waste and resource use are minimized, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value" (EC, 2015). So, while the EU's approach focuses more narrowly on waste and resources and opportunities for business, the Chinese concept of CE also incorporates pollution and other issues, as it is framed as a response to the environmental challenges created by rapid growth and industrialization (McDowall et al., 2017).

GDP, while OECD countries only require 0.54 kilograms on average (Mathews and Tan, 2016). Due to this gap, in the same year the *Chinese State Council National* appointed the *National Development and Reform Commission* instead of the mentioned *State Environmental Protection Administration* to take over the duty for promoting and implementing the CE in the country. Since then, Chinese policy makers proposed a Five-Year Plan specifically aimed at enforcing and promoting the CE. The activities carried out under this new framework can be addressed into three levels (called *circles*) simultaneously covering the areas of production, consumption, and waste management.

The first circle refers to the corporate or micro level. It chiefly involves the design of manufacturing plants, concerning issues such as cleaner production, *environmental management systems*, and product recycling schemes. To date, the most significant and successful activity at the micro-level of the CE has been cleaner production. Demonstration projects have been implemented in twenty-four Chinese provinces, involving a diverse range of industrial sectors, including chemical, construction materials, petrochemicals, pharmaceuticals, machine manufacturing, mining, textiles, power plants, metallurgical industry, light industry, transportation, and electronic industry (Geng and Doberstein, 2008).

The second circle is the inter-firm or meso level. It was created with the purpose to capitalise on the trading of industrial by products such as heat energy, wastewater, and manufacturing wastes, and is based on the promotion of eco-agricultural systems, waste trade markets, and especially *eco-industrial parks* (EIP), where companies valorise the economies of agglomeration between plants that interchange products and materials, reducing waste.[39] A typical Chinese EIP consists of an industrial production area, a scientific research area, a residential area, and a business and service area, where they all share the benefits of the CE, since they are connected with one another. Thus, the Chinese method of planning EIPs, which includes production and residential areas, emphasizes the establishment of integrated material, water, and energy management systems. This integrated approach encourages the creation and maintenance of eco-industrial networks among companies placed in these areas (Bleischwitzet al., 2022).[40]

In the third circle, also identified the macro-level or social level, the CE stimulates both sustainable production, and consumption activities through the development of eco-cities and eco-provinces that attempt to create a recycling-oriented and pollution prevention society (Geng et al., 2011). The CE cities and provinces are involved along four directions: i) the industrial system, ii) the infrastructure, iii) the cultural setting, and iv) social consumption. Chinese institutions selected the Guiyang City and Liaoning Province as China's first pilot experimentation of macro-level CE.

Within this framework, in January 2009 Chinese Government implemented the *Circular Economy Promotion Law*, indicating the involvement of the fundamental CE pillars in its economic development plans. This law was the world's first national regulation supporting CE at all levels of society. This law claimed that economic growth must

[39] All the companies belong to an EIP share common infrastructure and services and trade industrial by-products, such as heat, energy, wastewater, and manufacturing wastes for the reduction of use of new raw materials. To form an interdependent ecological industrial system, wastes or by-products of one level of production tend to become raw material or inputs for other productive cycles by the process of waste exchange, clean production, and other measures to achieve the closed-circuit circulation of materials and the multi-level use of energy (Su et al., 2013). As a result, an EIP is expected to maximize use of materials and energy and minimize release of wastes.

[40] EIPs are usually categorized as: i) *integrated* (i.e., with entities/operations from several industrial sectors); (ii) *sectoral* (i.e., with a dominant industrial sector); and (iii) *venous* (i.e., the dominant industrial sector is waste reuse and recycle) (Lyu et al., 2022).

pursue sustainable ways at every level of state policies. Following this law, new industrial policies created by the Government must meet the criteria for promoting a circular economy based on the three mentioned "R" principles: reduction, re-use, and recycling of activities in the production, circulation, and consumption of products (Li and Lin, 2016). Simultaneously, other regulations stimulate companies to implement management systems reducing resource usage and waste generation while improving resource recovery and recycling (Mathews and Tan, 2011). The key industries individuate for applying the principles of the EC concern high environmental impact sectors, such as steel, nonferrous metals, coal, electricity, chemicals, building materials, light industry, papermaking, textile, machinery manufacturing, agriculture (forestry), processing and utilization base of renewable resources.

At the societal level, a rapid increase in the number of pilot projects concerning the CE and their scope is in progress. To date, the *National Development and Reform Commission* has initiated two batches of national pilot projects, including participation by 109 enterprises, 33 industrial parks, seven provinces, and nineteen cities. Even large towns such as Shanghai, Yangzhou, Guiyang, and Hangzhou have plans for establishing an eco-city. Eco-cities and eco-provinces aspire to make the whole inherent area a CE; that is zones where recycled renewable energy produces close to zero carbon waste power for each existing activity.

23.2.2 Toward the future

The *Circular Economy Development Strategies Action Plan* created in 2013 has further embedded the idea of CE into Chinese legislation with clearly defined goals, such as the re-using 72% of industrial solid waste, a modern system for recovering at least 70% of waste products, raising energy productivity by 18.5%, increasing water productivity by 43%, and re-using 70% of some minerals that are heavy pollutants (Mathews and Tan, 2016). The 13th five-year plan (2016-2020) has also introduced specific measures devoted in recovering polluted areas. Moreover, it has favoured the creation of various institutions to support micro-level CE initiatives and the creation of 20 EIPs (Mathews et al., 2018).

The most recent 14th five-year plan, covering the timeframe 2021-25, aspires to develop the CE focusing on initiatives such as promoting recycling, remanufacturing, green product design, and renewable resources. This plan should impact all manufacturers doing business in China, but especially those using resources for production and creating waste (Bleischwitz et al., 2022).

The targets fixed by 2025 include (Yuan et al., 2020):

- improving resource productivity by 20%, and energy and water consumption per unit of GDP lower by 13.5% and 16%, respectively, compared to 2020 levels,
- reaching a utilization rate of 60% for bulk solid waste and 60% for construction waste,
- re-utilizing sixty million tons of wastepaper and 320 million tons of scrap steel,
- producing twenty million tons of recycled nonferrous metals,
- increasing the output value of the resource recycling industry to US$773 billion.

Additionally, this last five-year plan sets further interventions China should undertake to achieve higher compliance with the CE principles. The new guidelines include (Bleischwitz et al., 2022):

- promoting the green design of products,
- strengthening clean production by accelerating innovations and upgrading,

- enforcing the R&D concerning the utilization of wastes and reusable materials in industries such as ecological restoration, green building materials, and transportation engineering,
- promoting the co-processing of urban waste,
- improving the recycling network of waste materials,
- increasing the level of processing and utilization of renewable resources,
- encouraging the recycling and utilization of agricultural and forestry waste.

The final purpose of these interventions is to reach neutrality in greenhouse gas emissions in 2060. The goal is not easy to pursue, considering that China emitted 27% of the world's greenhouse gases in 2021 and has more installed coal capacity than the rest of the world combined.

Regardless of the real ability to reach these targets, it may be said that the era of relying on large amounts of resource consumption to drive economic growth is going to end as, currently, environmental protection and improvement are listed among the highest priorities on China's development agenda. This situation, unprecedented in Chinese history, represent an epochal change in the economic history of this country (Pesce et al., 2020; Bleischwitz et al., 2022).

Likewise, other Western countries, such as the USA and Germany, the Chinese Government tend to support these initiatives through preferential industrial recruitment and financial policies, such as land subsidies and tax incentives. Even the most adopted tool to measure CE performances – the *Material Flow Analysis* - [41] derives from western countries, recalling the EU's index (Geng et al., 2011). Anyway, the most imitated example of environmental and sustainability policies was the Japanese law for *Effective Utilization of Recyclables* implementing CE since 1991 (Qi et al., 2016). That is as, since 2000, Japan has showed the ambition to establish CE in the whole country, in order to join production, consumption, and waste management into a unique "recycle-oriented society".

As explained, *National Development and Reform Commission* is the leading institution for the policies concerning the EC. It is responsible for organizing and coordinating the academia, central government departments, industrial associations, and local governments during the study and design of the Chinese CE indicator system. Furthermore, the *Commission* regularly evaluates the performances of lower-level governments respect on the fixed targets, assuring that the policies planned by higher-level institutions are rightly implemented at the local level.

23.2.3 Perspectives and limits

Many scholars (e.g., Qi et al., 2016; McDowall et al., 2017) believe that the implementation of CE in China is gaining various benefits, in terms of economic, environmental, and social welfare. In addition to a contributing to unemployment problems, these benefits concern the quality of life for citizens, proper use of resources, and the environment, stimulating social justice at a higher level, preventing environmental poverty, and narrowing the income gap between population. The most important transformation, however, is related to the image of the

[41] As known, the *Material Flow Analysis* is a quantitative method of measuring the flow of natural resources and material through various scales of economy, which can range from whole cities to single rivers. It consists of methodically organized indices, where it then uses mass balancing to analyse the relationships between human activities, material flows and environmental degradation. This method can be altered to examine anything from all the energy flowing through an economy to single chemical element, such as carbon. The indicator system is particularly valid in identifying the inefficient use of energy, natural resources and materials, as well as how material flow shifts affect the countries' economy and environment.

country as a whole and of Chinese companies. In fact, citizens and consumers of Western countries have recently starting to modify their minds on the quality of the products that come from China and on the consequences for the environment of the productions made in that country. Until now, the image of low-quality productions with a high environmental impact has prevailed.

Nevertheless, China still has a long way to go to improve its credibility and reputation. The lack of specific and unanimously accepted indicators does not allow a precise calculation of the results obtained by China and its companies in terms of CE to be shown to Western countries more attentive to these issues.

However, an undoubtable aspect is that, with a framework of 280 measures related to sustainability, China has a long history of resource-oriented policies and implemented production-oriented policies. Hence, although the policies have quickly expanded only after the year 2000, the country can be considered a pioneer in the CE (Zhu et al., 2018). Moreover, the CE as interpreted in China differs from the concept in the EU through a broader environmental approach, e.g., by addressing air pollution and water and emphasizing less waste hierarchy[42]. Subsequently, China's policies toward the CE became more comprehensive over time, with a broad engagement of government agencies, an extensive and progressive coverage of recycling opportunities, production initiatives across multiple scales, and use of different policy instruments. Besides the initiative-taking efforts by the state actors, policymakers have largely benefited from knowledge from international experiences with a process of adoption and assimilation (Mohajan, 2021). They learned to innovative ideas and practices internationally, and integrated them into policies in a manner consistent with the local features, even if the internal context of China is too large to be considered as homogeneous (Geng and Doberstein, 2008).

This study also reminds that China's policymaking efforts toward the CE have been an enduring, incremental one, leading to a comprehensive set of related policies and state actors. The progress benefited from a top-down approach and integration of international and academic knowledge (Geng and Doberstein, 2008; Mathews and Tan, 2016). The objectives of the CE do not directly conflict with the country's ambitions to pursue a high level of economic development and industrialization. Conversely, CE addresses key issues China has been facing in its rapid growth, such as resource scarcity, low productivity, and air and water pollution. This positive picture of great dynamism nevertheless contains limits and barriers that slow down the path toward the full application of the CE principles and hinder the achievement of the targets set by the programs.

A first relevant limitation is that the current policy framework is too stressed on the means toward the CE and not enough on the ends and prospects of the CE itself. Most of the policies concern increasing available resource flows and resource productivity without attending to the ends of a sustainable scale of stocks of product and service provision for consumption and final needs. That is, little attention is paid to identifying an optimal level of consumption that can be judged sustainable over time. The related risk is to assume that production volumes can expand infinitely (Zhu et al., 2019; Pesce et al., 2020).

A second barrier is that the most of incentive-based measures is not market-based but company-based. In doing so, companies tend to internalize externalities increasing their competitiveness but without transferring the benefit an upper efficiency to the market. This situation also encourages companies to obtain policy incentives through lobbying that affects the policymaking process regarding the design of incentives themselves (Liu and Côté, 2017;

[42] *Waste hierarchy* is a tool for the evaluation of processes protecting the environment alongside resource and energy consumption, from most favourable to least favourable actions according a priority based on sustainability.

Zhu et al., 2019). Thus, it would be appropriate for companies to be more focused to consumer and market demands, instead of directing their attention to the search for incentives, as incentives do not necessarily correspond to the most appropriate market requests.

A third limitations regards the Chinese legal system, that currently is quite fragmented and lacks a unified platform for promoting the CE. For example, some of China's current tax regulations discourage businesses and the public from re-using or recycling resources, while the extremely low resource taxation system disincentives material recycling (Mohajan, 2021; Bleischwitz et al., 2022). So, to fill the gap that does not allow a unitary view of the whole policies and strategies to reach the target, the legislation should also be improved.

A fourth trouble emerging in this country is the weak applying of the regulations assuring the respect of the rules. The linkage between noncompliance with a regulation and the punishment for noncompliance that can be judged as inadequate. That is, because injured parties are not adequately compensated, and some environmental crimes receive administrative instead of criminal punishment (Su et al., 2013).

A further barrier to the diffusion of CE in China concerns the low presence of state-of-the-art environmental technologies, due to the inadequateness of technical capabilities and financial resources (Mathews and Tan, 2011). Systematic efforts by institutions to try to close these gaps are still lacking.

23.3 The complex transition of India toward of circular economy

23.3.1 Background

India is a nation known to have many contradictions. Having recently become the most populated country in the world, it is also characterized by wide inequalities and types of production carried out mainly by a myriad of small and very small enterprises with methods that are not up to date on the technological side and without much respect for the preservation of resources or the environment in general. These circumstances result in heavy repercussions on the endogenous context, both on the environmental and social side, but also from the exogenous side, penalising the image and reputation of Indian companies and of the country as whole (Ghosh, 2020; Ardra and Barua, 2022). It is clear, therefore, that the adoption of CE criteria holds considerable importance for its economy and the world economy. At present, however, although multiple directives have been issued in this regard, there is a lack of a comprehensive framework that compels or incentivizes companies to pursue sustainability principles (Utkarsh and Ahluwalia, 2018. Ghosh et al., 2021).

23.3.2 The municipal solid waste

The reasons concerning the previous brief description are many and they will be explained shortly. First, it should be mentioned that, according to local scholars (Rehman et al., 2016; Sharma et al., 2021; Lahane and Kant, 2022), India's main problem concerns *municipal solid waste* (henceforth MSW)[43] India currently produces 62 million tons

[43] MSW is here considered according to the definition of *The World Bank* (World Development Indicators, 2012) as: "non-hazardous waste generated in households, commercial and business establishments, institutions, and non-hazardous industrial process wastes, agricultural wastes and sewage sludge".

of solid waste per day. Based on changing consumption patterns and rapid economic growth, this volume will reach 165 million tons by 2030 and 436 million tons by 2050.

The generation of 62 million tons is further divided into hazardous waste, including biomedical waste (about 4.5 million tons), plastic waste (about 3 million tons), and electronic waste (3.2 million tons). Of 62 million tons of solid waste, only 20% is recycled. The most significant recycling component concerns electronic waste. About 50 percent of it is processed to extract valuable metals such as gold, silver, platinum, and other expensive ones that are then resold (Goyal et al., 2018; Kumar and Agrawal, 2020). As in other developing economies, the most common method of disposing of the remaining 80 percent of MSW involves storing it in open landfills, in most cases illegally, thus, spilling pollutants into soil and water. As an alternative to landfill, wastes are incinerated, releasing toxic gases and pollutants into the atmosphere. Both prevailing methods, therefore, severely affect human health and sustainability. Waste proliferation is believed to be connected to increasing levels of debilitating diseases, neurological disorders, respiratory problems, and birth deformities among Indian citizens (Mutz, 2015).

Although this sector is regulated by various legislations enacted by the *Ministry of Environment, Forestry, and Climate Change*, in cooperation with the *Central Pollution Control Commission*, state governments, and municipalities, waste management continues to be carried out primarily as a fragmented and unorganized activity, employing 39 million workers. This number represents nearly 3 percent of the population. People working in this sector usually lack adequate training, safety measures, and awareness of the risks they face. Not surprisingly, they have a life expectancy of 45 years and spend 30 percent of their income on medicine (Fiksel et al., 2021).

The remaining 80% of MSW is not recycled mainly due to insufficient municipal services. In most cities, the dustbins installed for waste collection are not cleaned regularly, resulting in people dumping household waste along roadsides, street corners, and in vacant lots, thus creating unauthorized, unhygienic, and unsustainable local landfills (Kumar and Agrawal, 2020).

In rural areas, including about 377 million people, agricultural wastes, including crop and animal residues, are often burnt in the field, or used as traditional household fuels. These practices have resulted in severe air, soil and water pollution, creating health problems for workers and nearby households. Currently, recycling and composting programs are unable to keep pace with the growth of waste, although, from few years, some startup companies and NGOs are introducing new solutions ranging from high-tech waste processing to improve training and support for waste picker communities.

In addition to the constant rise in population, the fast increase in municipal waste in India is primarily due to the diffusion of consumerism. In turn, consumerism has been fostered by the quick improvement of inhabitants' average income and to the growth of middle class, as well as from the higher number of workers with purchasing power, from the interest of foreign retailers to collect market share, and relevant change in consumers' aspirations to enlarge the set tangible products they possess (Utkarsh and Ahluwalia, 2018; Ardra and Barua, 2022). However, while companies firstly aim to capitalize their profit avoiding investments in sustainability that do not ensure an improvement in the economic-financial balance, the need for waste management practices is left to the low effectiveness measures of Government, local entities, and citizens.

To tackle the consequences of waste produced by consumerism, since 1991 the Indian Government has launched the so-called "launched the eco-labeling 'Ecomark' scheme, to increase consumer awareness, for easy identification of environment-friendly products" (Yaduvanshi et al., 2017: 5). This, many companies have included green activities in their business and products. Adopting green consumerism is a promising approach to reducing environmental impacts (Yaduvanshi et al., 2017; Lahane and Kant, 2022). In general, however, a significant proportion of the population still has a high level of poverty and is unwilling to pay any additional costs to have

more sustainable goods/services (value for money), especially in the emerging rural markets (Singhal et al., 2019; Nudurupati et al., 2022).
A second well-founded reason for the steep increase in MSW is the heavy urbanization, as the percentage of people living in urban areas has grown to 37.7% in 2015, as compared to 17.29% in 1950. Anyway, big cities are able to "collect around 70 to 90% of MSW generated, in comparison to smaller cities and towns that gather less than 50% of waste generated" (Yaduvanshi et al., 2017: 3).
A third motive concerns citizens' lack of awareness of environmental and sustainability issues which does not solicitate companies to adequate their productive systems. Not by chance, researchers (Fiksel et al., 2021; Nudurupati et al., 2022) observe that the adoption of EC in Indian companies still is an infancy phase, despite various government-sponsored initiatives and adherence to international targets. Even so, the investigations show a moderate awareness of CE, but which does not correspond to actual consumption choices. For instance, the *Green Living Survey* conducted in 2014 found that most Indian consumers are familiar with green products, have confidence that green products are better for the environment, and feel that bio-based ingredient enhance the desirability of a product. But this awareness does not translate into purchasing decisions. That is because although citizens perceive environmental degradation and realize that different choices need to be made, too many of them are still struggling to meet daily needs. Thus, sustainability issues take a back seat (Kamble et al., 2020). In addition, people's level of confidence in buying green products is very low because they are unsure of their eco-friendly nature. This approach based on consumers, therefore, cannot be the only solution to solve the country's MSW problems (Kumar and Agrawal, 2020).

23.3.3 The perspectives

A report drafted by the Ellen MacArthur Foundation (2016) believes that there would be relevant environmental and economic benefits if India adopts the principles of sustainability on a large scale, and also companies would obtain increasing in competitiveness. The path to achieving these expected benefits, however, still appears long.
That is although the Indian Governments' interest in sustainability issues is somewhat dated. In 1986, the *Environment Protection Act* was established, followed by a series of other regulations to support sustainable waste management to protect the quality of the environment and reduce pollution from all potential sources. Unfortunately, these regulations have not been very successful. Therefore, in 2016 a series of more stringent rules were issued for MSW management, including specific requirements for plastic wastes, electronic wastes, construction and demolition debris, biomedical wastes, and hazardous wastes. Despite these regulatory efforts, the Indian economy is expected to generate unrecycled growing waste streams due to increases in population, urbanization, crops, and livestock, resulting in significant human health and environmental impacts even in the following years. The growth of international trade will also contribute to increasing MSW. On the one hand, India exports finished products to Western countries, on the other hand it tends to import end-of-life products to be reused or dismantled to recover valuable components.
More recently, however, pilot projects related to various technologies for the effective utilization of waste have been put into practice, such as waste-to-energy, transfer-storage-disposal, composting, bio-methanation, co-treatment, and some other processes. These waste management initiatives have been able to convert waste streams into business models, introducing integrated management facilities that support the treatment of multiple wastes in a single facility, with low time and cost. At the regulatory level, the main initiatives supporting EC implementation are the Swachh Bharat Mission launched in 2014, the establishment of a series of waste

management rules documents, the renewable energy targets, the publication of the drafts *Nations Resource Efficiency* (2019) and Battery *Waste Management Rules* (2020), and the incorporation of zero-waste policy in SMEs management which constitute the main typology of Indian firm (Nudurupati et al., 2022; Sohal et al., 2022).
However, the low effectiveness of the regulations can be also traced back to the weak attention paid by Government to people engaged in this sector with formal recognition of the waste management industry. This weak attention explains why the industry does not systematically adopt new techniques and technologies for waste collection and sorting (Fiksel et al., 2021).
Another direction being pursued relates to energy production. Given the high incidence of energy poverty, a major challenge for the country is to ensure universal access to clean electricity for the population by 2030 (Sawhney et al., 2016; Gosh et al., 2021). In 2018, the Indian Government announced a renewable capacity target of 227 GW to be achieved by 2022 and 275 GW to be achieved by 2027. However, electricity generated by the plants is only 66.4 MW per day. Operation and maintenance problems hinder the 100% utilization of existing capacity.
Even wastewater is a major challenge. They are about 38,000 million litres per day, but the treatment capacity is lower than 12,000 million litres per day (CPCB, 2009).
Regardless of these efforts, an underlying problem for disseminating EC principles in India concerns a cultural aspect, as the concept of CE is still new, as it is for other developing countries. With the increasing tonnage of waste per year, a pressing need to introduce an innovative cyclic model which implies the use and re-use of waste and to consider “waste as a resource” emerges (Kamble et al., 2020). In this view, consumer acceptance of remanufactured or recycled products is an essential first step to the success of the closed-loop supply chain and to achieving the goal of CE. However, as mentioned above, researchers have verified that consumers are reluctant to purchase remanufactured products. Some investigations (Nudurupaqti et al., 2022; Sohal et al., 2022) show that, nowadays, environmental awareness has a non-significant impact on Indian citizens’ consumption choices. But the CE can only be realized if consumers’ attitudes are positively modelled toward recycled and remanufactured products. To this end, it would be important to improve communication with citizens through the dissemination of comprehensive product information (Singhal et al., 2019). Therefore, it is necessary to introduce programs to raise people’s awareness and affect their purchasing behaviours regarding MSW, train staff to handle safe disposal of MSW, especially e-waste, and produce eco-friendly products (Sharma et al., 2121).
In better detail, about citizens features, it was also noted (Kamble et al., 2020) that the female population shows less awareness compared to the male population, as well as people under 30 years of age. Qualification and high level of education support a higher awareness as well as, in terms of hierarchical levels, employees show an awareness lower compared to that of managers and supervisors. Therefore, progress in the education level could improve the sensitiveness toward CE.
Another type of intervention concerns the *Green manufacturing*, here considered in a generic manner as manufacturing practices that do not harm the environment during any productive phases. Green manufacturing involves the green design of products, use of eco-friendly construction materials and packing, and re-use after the product’s end of life. In doing so, it has been demonstrated that the depletion of natural resources and production of trash tend to be reduced (Rehman et al., 2016). By emphasizing rationalizing materials and re-using components, green manufacturing encompasses many manufacturing principles, including 6Rs i.e. reduce, re-use, recycle, recover, redesign, and remanufacture. Thus, *Green manufacturing* contributes to waste management, environmental protection, regulatory compliance, pollution control, and other allied requirements (Sohal et al., 2022). To improve the effectiveness of this approach, however, it is necessary to involve firstly the myriad small and medium enterprises (SMEs) that comprise the core of India's industrial system. In a large developing country

such as India where much of the SME sector is not yet fully organized and often receives limited support by government improvement programs, the journey to become integrated into the CE is very difficult (Nudurupati et al., 2022; Pereira et al.; 2022).
Summarizing, to capture around half a trillion dollars' worth of economic value to be generated through the CE in India by 2030, as forecasted by the *Ellen MacArthur Foundation* (2016), it is important to understand specific challenges that prohibit achievement of the full potential of CE. Some of these challenges regard the supply side. They concern measures such as filling the gaps concerning suitable infrastructure to support "6R" for large quantities of wastes, improving the logistic sector (reverse logistic, circular supply chain…) aimed to support the collection, separation of used materials and extraction of raw materials, and the practices for the diffusion of education/capabilities among companies to undertake the "6R" activities in a safe and environmental-friendly way (Goyal et al., 2018; Sohal et al., 2022). Other measures regard the demand side and are linked to citizens' cultural pattern toward the indispensable sustainability pathways (Mutz, 2015; Sharma et al., 2021). Thus, they include initiatives to change mindset of the "throwaway" society for acceptance of CE related products. Anyway, all the measures presuppose a stronger governmental support through incentives and penalties, with large-scale controls of the performances obtained in the different directions of intervention (Rehman et al., 2016; Kamble et al., 2020). Until now this aspect has been often missing in the Indian legislative context.

23.4. Conclusions

This brief review of the path to the circular economy (CE) followed by these two big countries that are united by an impetuous economic growth exhibits clear differences. On the one hand, China, led by a top-down government approach, shows an early understanding of the need to transition towards CE and is more stringently pointing the way forward for companies and citizens. A choice driven presumably by the goal of consolidating its position as the world's leader exporter with respect to those foreign markets whose consumers are more sensitive to the sustainable development and to the necessity to implement CE pillars. On the other hand, India, in addition to begin its pathway slightly later, has accumulated a further clear gap. That is, although its being the world's largest democracy makes it easier to establish partnerships with Western countries, the social and environmental consequences of the weak attention to sustainability issues are perhaps even more pronounced than in China. However, we must remember that China currently has a higher level of resources to invest in sustainability than India.
A silver lining joining both countries is the growing awareness of the unpostponable need to accelerate the adoption of CE principles. This awareness is certainly positive for the pathway toward the sustainable development of the whole world since these two countries account for nearly 36% of the global population and 22% of GDP. The discussed landscape also let emerge at least three considerations confirming the prevalent literature orientation.
A first observation regards the predisposition toward the adoption of CE principles that seems directly related to the level of well-being of communities. When populations are focused on the most pressing problems related to finding resources to survive, sustainability issues take a back seat. Thus, local authorities of less developed countries, while perceiving the existence of an environmental and social issue, believe that the problem should be addressed first and foremost by more affluent countries.

A second consideration concerns the fact that it seems equally unrealistic to believe that markets and firms can autonomously lead toward a widespread context of sustainability. If the CE is destined to become the future mantra of economic development, as more and more situations and events are confirming, actions led by institutional bodies at the national as well as international level are indispensable. The adoption of SDGs is certainly, to date, the most striking virtuous example. No less important, at the corporate level, is the growing practice of adopting reporting systems that in some way attest to the ability of companies to achieve economic performance consistent with, if not functional in, the other dimensions of development related to the environment and sociality. Environmental reports or social and sustainability balances, as well as the more advanced integrated reports, certainly represent an important step in this direction.

A third thought concerns the close relationship between safeguarding environmental conditions and social conditions. It is becoming increasingly clear that these two spheres cannot be separated. Where there is social degradation, there also emerges environmental degradation, and conversely. National and international institutions and bodies, therefore, must act with these interrelated dynamics in mind. Similarly, these bodies must consider that without investment in training and technical and technological innovations, it is difficult to pursue a true path to sustainable development.

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Chapter 24: Visioning four different circular futures: what could 2050 look like?

Martin Calisto Friant and Walter V. J. Vermeulen

Abstract: There are many competing visions regarding what a circular future entails and how it would transform our social, economic, and political systems. This chapter sheds light on these different circular discourses by asking the following research questions: what kind of society would different visions of a circular future seek to create by 2050? To answer this question, this chapter unpacks the four circular discourses developed by Calisto Friant et al. (2020). Results examine how these four discourses would organise and operationalise circular transport, energy, agriculture, and industrial systems in 2050. Results also explore the political systems and governance processes they would establish and the type of society, culture, and daily life they would create. Our chapter concludes that there is a real danger in following growth-based circular discourses and scenarios because their visions cannot be implemented within the boundaries of the Earth. Indeed, over 50 years of academic research has demonstrated that decoupling economic growth from environmental degradation fast enough to prevent climate breakdown and biodiversity collapse is impossible. Degrowth-oriented circular society approaches, on the other hand, might shed light on socially innovative transformations that can allow all humans to meet their needs within the ecological boundaries of the Earth.

Keywords: circular economy; circular society; futuring; sustainability; degrowth.

This chapter asks: what kind of society would different visions of a circular future seek to create by 2050? To answer this question, we explore what competing circularity futures propose for our transport, energy, agriculture, industry, political institutions, culture, and everyday life.

24.1 Introduction

In the past decade, the circular economy (CE) rose from a niche concept in the sustainable production and consumption literature to become a major component of any business, government, or civil society discourse on sustainability. A Google search for "circular economy" in 2012 would lead to around 80 thousand results, the same search now leads to over 80 million. However, the CE is nothing new, the metaphor of a circle to represent a sustainable economy has existed at least since the 1970s with Barry Commoner's magnum opus, "The Closing Circle" (Commoner 1971). The idea of a society that works in harmony with the natural cycles of the Earth can be traced even further back to the ancestral worldviews and ways of life of indigenous peoples throughout the globe (Kothari et al. 2019). The current definition and forms of implementation of CE are very diverse and still very much contested, with many different actors proposing different visions and discourses of CE, depending on their socio-economic perspectives and interests (Korhonen et al. 2018).

This chapter seeks to shed light on these different circular futures and scenarios by asking the following research questions: what kind of society would different visions of a circular future seek to create by 2050? To answer this question, this chapter unpacks the 4 circular discourses developed by Calisto Friant et al. (2020) to explore how these different approaches to circularity imagine the future. It does so by working with an artist to illustrate 4 images that represent the futures that each of the 4 discourse types would envision by 2050.

This chapter is thus the result of a "futuring" thought experiment, where we unpack and draw out four circular discourses into the near future and critically engage with their sustainability implications. By collaborating with an artist to visualise each of these futures, we hope this chapter can help academics and practitioners better understand the different visions of circularity that currently compete in the discursive debate and to better grasp their key implications for human planetary well-being.

After explaining the methods (section 2), the article explores the four possible futures that each of these discourse types would envision by 2050 (section 3). Section 4 investigates which of these visions currently dominates the discursive debate on CE and discusses the sustainability implications of each of these futures. We conclude with final reflections and avenues for further research.

24.2 Methods and theoretical framework

The typology of circularity discourses developed by Calisto Friant et al. (2020) was chosen as the theoretical framework for this article as it is a typology that has been widely used by other academics for discourse and policy analysis on the topic (e.g. Arai, Calisto Friant, and Vermeulen 2023; Melles 2021; Ortega Alvarado et al. 2021; Palm et al. 2021). The framework is based on a comprehensive literature review on CE and all its related concepts, including both ideas from the GN and South. It is thus a broad and plural typology that embraces many different approaches to the topic in a holistic manner. It is particularly useful to this chapter's research aims, as the typology can help us envision the complexity and diversity of futures that different CE proposals entail in a coherent and systematic manner.

The 2x2 typology differentiates CE discourses based on 2 criteria. First, whether discourses are *optimist* or *sceptical* regarding the possibility that economic growth can be decoupled from environmental degradation fast enough to prevent a socio-ecological collapse (eco-economic decoupling). Second, whether discourses are *holistic* by including social justice and political empowerment considerations or *segmented* by focusing on resource efficiency alone. This differentiation leads to 4 broad circularity discourse types: *Technocentric Circular Economy* (*optimist* and *segmented*), *Reformist Circular Society* (*optimist* and *holistic*), *Transformational Circular Society* (*sceptical* and *holistic*), and *Fortress Circular Economy* (*sceptical* and *segmented*) (see **Figure 24.1**).

		Approach to social, economic, environmental, and political considerations	
		Holistic	**Segmented**
Technological innovation and ecological collapse	**Optimist**	**Reformist Circular Society** - **Assumptions:** reformed form of capitalism is compatible with sustainability and socio-technical innovations can enable eco-economic decoupling to prevent ecological collapse. - **Goal:** human prosperity and well-being within the biophysical boundaries of the earth. - **Means:** technological breakthroughs and social policies that benefit humanity and natural ecosystems. - **Example concepts:** natural capitalism, cradle to cradle, the performance economy, the natural step, the blue economy, regenerative design, sound material-cycle society, doughnut economics. - **Proponents:** various international organizations, academics, large foundations, and some governments.	**Technocentric Circular Economy** - **Assumptions:** capitalism is compatible with sustainability and technological innovation can enable eco-economic decoupling to prevent ecological collapse. - **Goal:** economic prosperity and development without negative environmental externalities. - **Means:** economic innovations, new business models, and unprecedented breakthroughs in CE technologies- - **Example concepts:** industrial ecology, reverse logistics, biomimicry, industrial symbiosis, extended producer responsibility, cleaner production, bioeconomy. - **Proponents:** some academics, many corporations, various national and city governments, and international organizations.
	Sceptical	**Transformational Circular Society** - **Assumptions:** capitalism is incompatible with sustainability, and socio-technical innovations cannot bring absolute eco-economic decoupling to prevent ecological collapse. - **Goals:** a world of conviviality and frugal abundance for all, while fairly distributing the biophysical resources of the earth. **Means:** complete reconfiguration of the current socio-political system and a shift away from productivist and anthropocentric worldviews. - **Example concepts:** conviviality, steady-state economics, permacircular economy, degrowth, eco-anarchism, Buddhist economics, buen vivir, ubuntu. - **Proponents:** many academics, social movements, bottom-up circular initiatives, and indigenous peoples.	**Fortress Circular Economy** - **Assumptions:** there is no alternative to capitalism and socio-technical innovation cannot bring absolute eco-economic decoupling to prevent ecological collapse. - **Goal:** maintain geostrategic resource security in global conditions where widespread resource scarcity and human overpopulation cannot provide for all. - **Means:** innovative technologies and business models combined with rationalized resource use and migration and population controls. - **Example concepts:** the tragedy of the commons, the population bomb, overshoot, disaster capitalism, capitalist catastrophism. - **Proponents:** survivalists, a few academics, some geostrategic think tanks, and state policies.

Figure 24.1: Circularity Discourse Typology (adapted from Calisto Friant, Vermeulen, and Salomone 2020)

To develop a visual representation of the 4 discourse types and their proposed futures we worked with an artist and designer, Anke Muijsers. Through a series of collaborative sketching exercises, we developed an illustration of each of these futures (see **Figure 24.2**)[44]. These figures detail the type of future and socio-economic system that each circularity discourse would imagine for 2050, with the mix of agricultural, industrial, housing, energy, consumption, and transport systems they would engender. We sought to create visual representations that are both complete and comprehensive but also simple and easy to understand so they could be used as education and workshop materials with citizens, researchers, practitioners, students, and other actors.

24.3 Four different visions of a circular future

24.3.1 The Technocentric Circular Economy Future

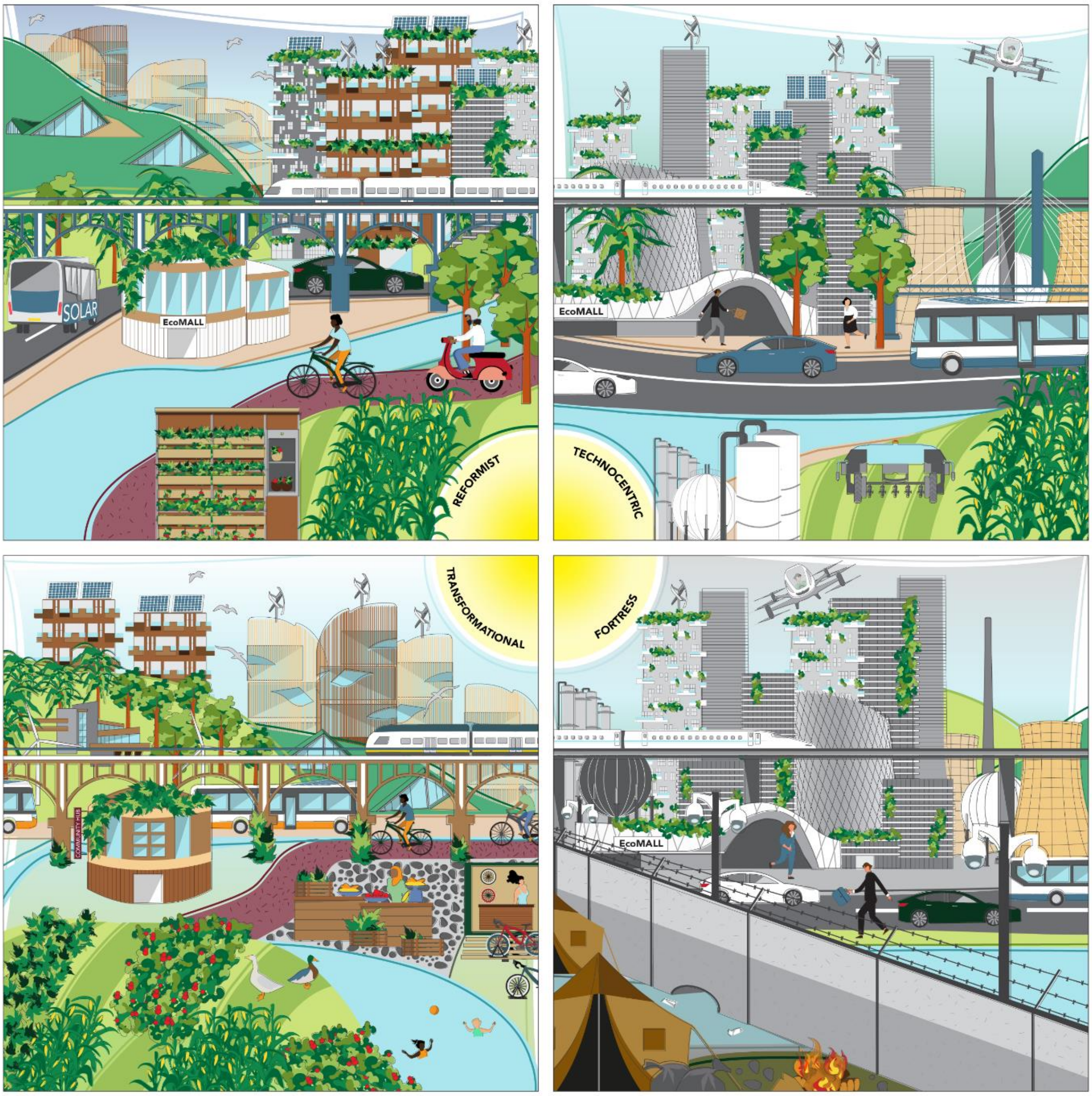

Figure 24.2 Visual representation of the circularity discourse typology (Calisto Friant 2022)[1]

[44] These artistic representations (figures 2, 3, 4, 5 and 6) were illustrated by Anke Muijsers from https://visual-research.studio/

Technocentric Circular Economy (TCE) discourses are *optimist* about the capacity of technology to prevent socio-ecological collapse as well as *segmented* as they don't include social justice and political empowerment considerations (see **Figures 24.1** and **24.3**). These discourses seek to reconcile economic development with ecological sustainability through innovative business models and technological breakthroughs, especially in resource recovery, biotechnology, and renewable energy.

In a TCE future, industrial output and energy demand continue to grow by using many different sources of energy, including solar panels, wind turbines, hydrogen, biofuels, nuclear, and even fossil fuels such as gas and oil with carbon-capture and storage technology to prevent greenhouse gas emissions. Agriculture is highly efficient and automatised and uses artificial intelligence (AI), robotisation, biotech and genetically modified organisms (GMOs) to increase resilience and productivity and reduce losses. This industrial agriculture system thereby supplies food for human consumption and industrial feedstock to produce biofuels and advanced biomaterials (such as bioplastics), all while recuperating organic wastes from urban areas through bio-digestion and waste-water recycling. Transport systems include high-tech innovations such as autonomous vehicles, high-speed rail, and passenger drones, as well as green aircraft powered by biofuels, hydrogen, or electric batteries. Buildings are made from recovered or innovative sustainable materials and are packed with smart technologies, which allow energy-efficient insulated housing, malls, and offices to rise surrounded by green walls, wind turbines and solar panels. New recovery technologies and businesses flourish in this society, with myriad innovations to recycle all types of waste and repair, remanufacture or refurbish disused products.

Many industries switch from selling specific goods like cars, smartphones, and washing machines to providing services like transportation, cleaning, lighting, or computing (so-called product-service systems). Industries also start producing closer to consumption markets with innovative robotisation and machine learning technologies. This also allows for a strong symbiosis between and within urban and industrial clusters, which efficiently and continuously re-use and recuperate wastes to manufacture new products.

TCE visions do not address social considerations, so current social relations and working practices remain broadly unchanged and thereby replicate present racial, class, gender, property, health, and ethnic disparities. Overall, a TCE vision seeks to create a highly productive and efficient society with an abundance of technical solutions that allow for high material standards of living and the continued reproduction of capitalist socio-economic relations.

Figure 24.3 Visual representation of a Technocentric Circular Economy future (Calisto Friant 2022)[1]

24.3.2 The Reformist Circular Society Future

Reformist Circular Society (RCS) discourses are *optimist* about the capacity of technology to prevent socio-ecological collapse and *holistic* as they integrate many social justice and political empowerment considerations (see **Figures 24.1** and **24.4**). These discourses seek to create a sustainable circular future through a combination of innovative business models, social policies, and technological breakthroughs. RCS visions thus add a social justice lens to the many technical and business innovations of TCE visions.

An RCS society combines high-tech innovations and industrial processes with greater care for workers' well-being and respect for human rights. It is a society where technology has brought nature closer to humans with a myriad of nature-based solutions like green walls and parks that mitigate heat waves and floods. It is a future where industrial processes operate like natural ecosystems, sharing resources between localised manufacturing hubs and cities to continuously re-use wastes to produce new goods. Innovative technologies like robotisation, 3D printing, chemical recycling, big data, and artificial intelligence enable the re-localisation of industrial processes and the mining of urban areas for secondary materials. This is all powered by abundant renewable energy from large-scale solar and wind farms, hydroelectric dams, and geothermal plants. This smart energy grid also provides power for an electrified transport system combining high-speed rail, autonomous vehicles, and passenger drones, with electric scooters, buses, bikes, and aeroplanes.

Buildings are constructed with recovered resources and sustainable bio-sourced materials. Urban spaces are optimised, renovated, insulated, and greened as much as possible. The need for offices and housing is reduced thanks to co-working and house-sharing platforms. A myriad of sharing economy activities emerge tanks to new information technology platforms enabling people to rent, lend, and share tools, knowledge, work, cars, bikes, resources, and much more. In this networked economy, people become less inclined to own products and rather seek access to their transportation, cleaning, computing and other needs. Companies thereby switch from selling products to providing services through product-services systems like leasing phones and washing machines instead of selling them.

Agriculture systems are also transformed by combining organic agricultural practices with high-tech innovations like vertical farming, aquaponics, hydroponics, autonomous tractors,, and genetic engineering. This enables the provision of diverse diets of fresh produce for humans, the production of biofuels for energy use, the supply of biomaterials for industrial applications (such as bioplastics). Bio-digestors and wastewater recovery systems also enable the efficient re-utilisation of urban organic waste as fertilisers.

The nation state remains the dominant model of governance, but some local participatory mechanisms are encouraged (such as participatory budgeting) and transparent, open, and accountable representative institutions are reinforced. The welfare state is also strengthened and redistributes excessive inequalities while ensuring the access of basic services for all, such as education, healthcare, and social security. Moreover, international organisations are empowered to address global sustainability challenges in a collaborative manner, such as climate change, poverty reduction, and biodiversity protection.

While privately owned corporations remain the norm, and capitalist power relations subsist, a greater voice is given to unions, workers, and stakeholders in business boards. A triple bottom line of profit, planet, and people thus guide corporations and help create socially responsible and environmentally sustainable business models. An anthropocentric and liberal worldview based on the respect of human rights and an aspiration to pursue sustainable development within capitalist market relations guides socio-cultural practices.

Figure 24.4 Visual representation of a Reformist Circular Society future (Calisto Friant 2022)[1]

24.3.3 The Transformational Circular Society Future

Transformational Circular Society (TCS) discourses are *sceptical* about the capacity of technology to prevent socio-ecological collapse and *holistic* as they integrate many social justice and political empowerment considerations (see **Figures 24.1** and **24.5**). These discourses seek to create a fair, democratic, de-colonial, and sustainable post-capitalist future where humanity and nature live in mutual harmony by re-localising and redistributing power, wealth, and knowledge. It is a society where industry belongs to workers, democratic public institutions, and communities rather than private investors and bondholders. Profit motives and endless economic growth imperatives thus no longer dictate economic and political decisions. It is a society where power is equally shared amongst all thanks to a plurality of deliberative democracy innovations such as citizen assemblies of randomly selected citizens, participatory budgeting processes, referendums, and citizen initiatives. It is an economy that redistributes wealth and resources from those that have the most to those that have the least, thanks to high taxes on wealth and a diversity of social justice programs like job guarantees, universal healthcare, public childcare, free education, abundant social housing, social security, and universal basic income (UBI) etc.

It is an economy run through social and solidarity economy practices of care, reciprocity, and solidarity. There is hence an abundance of economic and social initiatives that care for humans and non-humans alike, such as repair cafés, community gardening, fab-labs, cooperative firms, support groups, sharing initiatives, convivial biodiversity conservation and ecosystem regeneration projects etc. Working time is reduced to allow people to be involved in all the above community activities or any personal, artistic, spiritual, relational, or family project. Productive work, personal achievement and competition are no longer the foremost goals in life, allowing for slower, more meaningful, and convivial forms of life. Citizens thereby gain a renewed sense of freedom and control over their time and the meaning they wish to give to their lives.

Industrial and manufacturing systems are as low-tech as possible and focus on providing for real human needs rather than endless artificial wants. Products are highly durable and easily repairable and upgradable. Product patents and manuals are open and free to facilitate modularity and innovation. People thus partake in a plurality of repair, repurpose and do-it-yourself activities that give them tangible control over their material resources.

Global energy use is reduced to sustainable levels for the biosphere, and it is shared to ensure enough energy is available for everyone. Moreover, energy is produced in socially and environmentally respectful manners thanks to decentralised energy grids of community-owned renewable sources like wind turbines, geothermal plants, and solar panels.

All agriculture is organic, highly biodiverse, and as local as possible, utilising urban food waste for community composting and urban agriculture. Cooking and food preparation is cherished and slowed down, with deep care and appreciation for diverse, seasonal, healthy, plant-based ingredients that ensure human and planetary well-being.

Transportation needs are reduced as much as possible by planning inclusive walkable cities, with easy access to local goods and services for all thanks to plenty of green spaces, accessible sidewalks, and bike lanes, as well as free and quality public transport systems. This leads to convivial cities and neighbourhoods with access to local markets, parks, communal spaces, gardens, and public services for everyone, regardless of class, gender, ethnicity, sexual orientation, race, (dis)ability or age. Long-distance travel is reduced to a minimum and, when necessary, it happens by train or sailboat and supports community tourism that respects local cultures and ecosystems.

The construction of additional buildings is reduced to a minimum by focusing instead on repurposing unused or under-used buildings and preventing the unfair and unsustainable accumulation of building stock through. When infrastructure construction is necessary to meet social needs, it focuses on using local materials and socio-ecologically responsible building practices. Biodiversity is cherished by protecting ecosystems, prioritising green infrastructure, and replacing unnecessary parking, roads and highways with green belts and roofs.

Figure 24.5 Visual representation of a Transformational Circular Society future (Calisto Friant 2022)[1]

24.3.4 The Fortress Circular Economy Future

Fortress Circular Economy (FCE) discourses are *sceptical* about the capacity of technology to prevent socio-ecological collapse and *segmented* as they don't include social justice and political empowerment considerations (see **Figures 24.1** and **24.6**). They describe a future in which biophysical stability is severely weakened and geostrategic resource security is sought through technological innovations and top-down controls on people and resources. FCE discourses are concerned about the tangible shortages caused by overpopulation and the overconsumption of natural resources. Yet, instead of envisioning a utopic vision to solve these socio-ecological challenges and prevent planetary overshoot, they see climate breakdown and ecological collapse as inevitable due to the entrenched nature of capitalist power relations and a generally negative vision of human nature. Therefore, rather than attempting to describe the world as it should be, FCE discourses focus on describing the world as it will most likely be if current unsustainable socio-ecological trends continue.

FCE discourses thus see a world where people seek to protect themselves and maintain access to resources despite the surrounding collapse. Protection from mass climate-induced migration is intensified with heavy security apparatus of walls, surveillance systems and migration controls. Military and economic domination and coercion are used to secure access to key resources and build high-tech industrial societies. Minerals for wind turbines and solar panels, uranium for nuclear power plants, and land for bio-fuels are thus obtained throughout the globe by some societies, despite global shortages that prevent others from accessing these resources. Military and police power also enables some societies to impose the conservation of critical biodiversity hotspots, and to restrict access to fossil fuels. It thereby secures key planetary functions and resources for some humans to enjoy by imposing sufficiency on all others.

Islands of material wealth and abundance are hence created by neo-colonial and imperial practices. This allows some societies to maintain high-speed rail networks, autonomous vehicles, passenger drones and malls filled with electronics, clothing, furniture, and other goods for those that can afford them. Climate engineering, autonomous tractors, AI, GMOs, and biotechnology maintain a limited supply of foods and industrial feedstock for those who can afford them. Water scarcity and pollution are rampant due to constant droughts, floods, and heatwaves, but new water-saving, decontamination and desalination technologies provide water access for those who can pay for it.

In the most powerful cities, buildings and urban systems are highly efficient and interconnected thanks to big data, AI, and the internet-of-things to ensure the effective use of limited resources. Innovative recovery technologies and strong integration between powerful consumption and production centres ensure the efficient recovery, remanufacture, refurbishment, and recycling of waste materials for new products and services. Some nations use high-tech robotisation, automatization, bioengineering, and machine learning technologies to create eco-industrial systems with optimum labour, energy, and material efficiency. However, these industrial tools and resources remain inaccessible to most of the Earth's population. In fact, for most of humanity, informal settlements and refugee camps are the norm, and people undertake multiple informal activities (such as waste picking and scavenging) to make a living due to widespread job scarcity.

An FCE future is a world where socio-ecological crisis has become the new normal. Current social disparities along racial, class, gender, property, health, and ethnic lines are reinforced and exacerbated as those with historical power are able to maintain access to the limited resources that remain. All in all, it is a bleak portrait of the future where a minority of people in a few countries secure a relative material abundance amidst a heavily degraded planetary system with strong resource constraints for most of humanity. It is circularity and sustainability for those that can afford it and imposed sufficiency for all the rest.

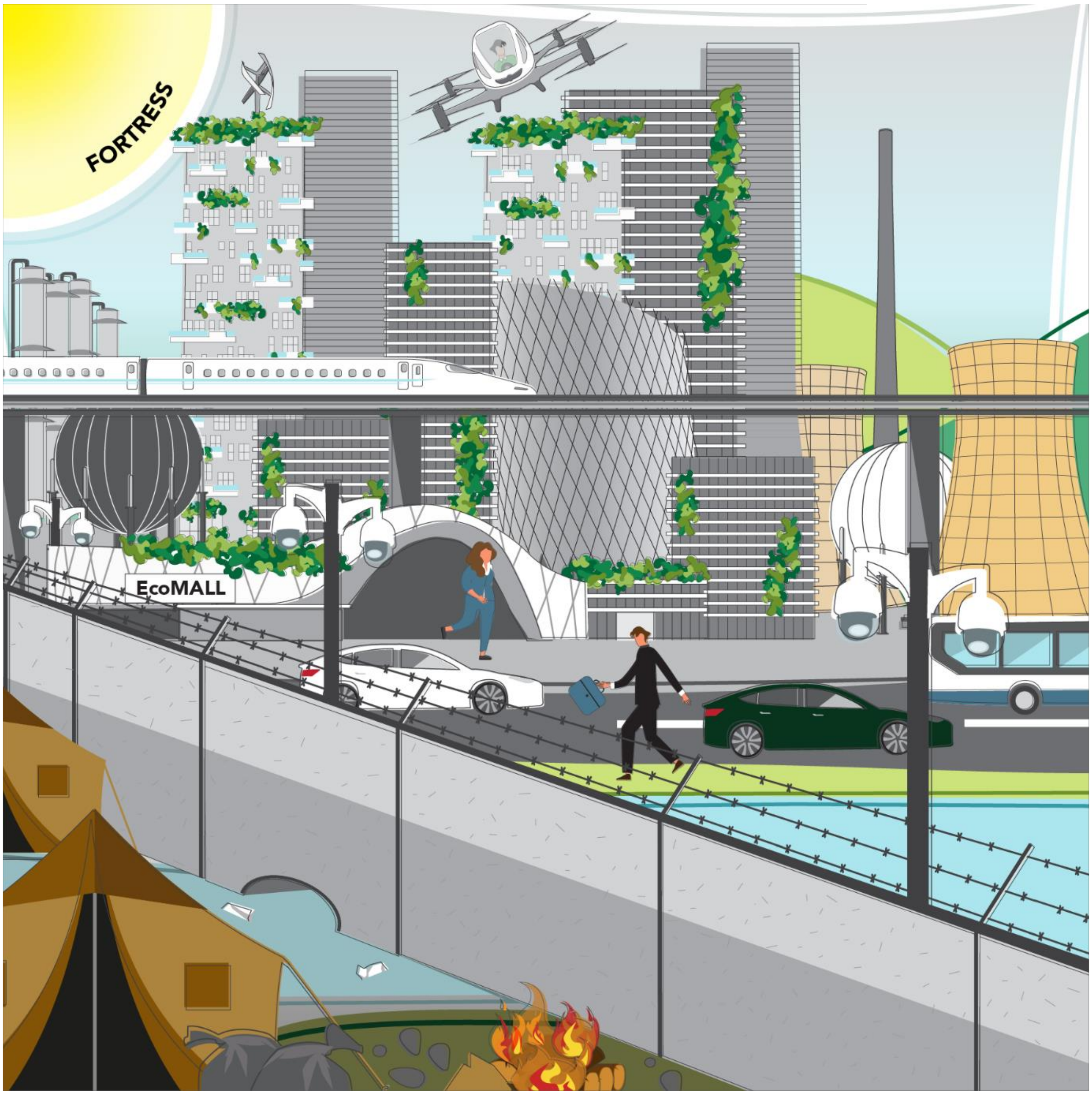

Figure 24.6 Visual representation of a Fortress Circular Economy future (Calisto Friant 2022)[1]

Table 24.1: Summary of sectoral transformations envisioned for 2050 by the four circularity discourse types

	Technocentric Circular Economy (*optimist* and *segmented*)	**Reformist Circular Society** (*optimist* and *holistic*)	**Transformational Circular Society** (*sceptical* and *holistic*)	**Fortress Circular Economy** (*sceptical* and *segmented*)
Energy	**Energy use increases** through the expansion of **solar, wind, hydrogen, biofuels, nuclear, and fossil-fuels with carbon-capture and storage**.	**Energy use increases** through the expansion of **smart grids**, **large-scale solar and wind farms, hydroelectric dams, and geothermal plants**.	**Global energy use is reduced to sustainable levels** and is **produced in socio-ecologically respectful manners** through **community-owned renewable sources** (mostly wind and solar)	**Energy use decreases for most of humanity but rises for the wealthy**, who can pay for new technologies (e.g. **biofuels, hydrogen, solar, nuclear, and carbon-capture and storage**).
Agriculture	**High-tech and highly automatised industrial agriculture** system using AI, robotisation, and GMOs to **produce food and industrial feedstock** (biofuels and biomaterials) and **recuperate urban wastes as fertiliser**.	**Combining organic agricultural practices with high-tech innovations** like vertical farming, AI, bio-digestors, robotisation, and GMOs to produce **food and industrial feedstock** and **recuperate wastes as fertiliser**.	**Agriculture is organic**, highly **biodiverse**, and **locally produced** using urban food waste for **community composting** and **urban agriculture**. **Healthy plant-based diets** ensure human and planetary well-being.	**High-tech and highly automatised industrial agriculture** system using AI, robotisation, and GMOs to **produce food and industrial feedstock** for those who can afford it.
Industry	Business models focus on **servicing and leasing**. **Re-localisation of production** through robotisation, and machine learning as well as advanced recovery technologies that **recuperate wastes from consumption centres**.	Business models focus on **servicing and leasing**. **Re-localisation of production** through robotisation, and machine learning as well as advanced recovery technologies that **recuperate wastes from consumption centres**.	Industry **as low-tech as possible** and focuses on **providing essential needs rather than endless wants**. It is run through **social and solidarity economy** practices including cooperatives, repair cafés, and sharing initiatives.	Powerful countries have **integrated production systems through robotisation, and machine learning** as well as advanced **recovery technologies** that **recuperate urban wastes.**
Building and infrastructure	Focus on using **recovered or innovative sustainable building materials** as well as **smart technologies and big-data** solutions to improve energy efficiency.	Focus on using **sustainable building materials, smart technologies, and nature-based solutions** to improve eco-efficiency as well as **co-working and house-sharing** to optimise the use of space.	Construction is reduced to a minimum by focusing on **repurposing unused buildings** and **preventing the unfair and unsustainable accumulation of building stock.** Construction is based on **socio-ecologically responsible local materials.**	**Powerful cities use innovative, sustainable building materials** as well as **smart technologies, AI and big-data** solutions to improve energy efficiency. **Informal settlements and refugee camps** are the norm for the rest of humanity.
Transport	Focus on **high-tech private transport through** autonomous vehicles, passenger drones combined with high-speed rail and aircraft powered by biofuels, hydrogen, or electric batteries	**High-tech electrified transport system combining private and public systems** such as passenger drones, scooters, bikes, autonomous vehicles, buses, high-speed rail, and aircraft powered by green fuels.	Transportation needs are reduced by planning **walkable cities**, with easy access to local services, **accessible sidewalks**, **bike lanes, and free public transport**. Long-distance travel is reduced are privileges **rail and sail**.	**High-tech transport is available for the wealthy,** including autonomous vehicles, passenger drones, high-speed rail and aircraft powered by biofuels, hydrogen, or electric batteries.
Consumption	Consumption focuses **leasing and access rather than ownership**.	Focus on **leasing and access rather than ownership**. Many **sharing economy platforms** so people can rent, lend, and share tools, work, cars, bikes etc.	Products are **durable, repairable,** and **upgradable**. People have greater control over their material resources as parents and manuals are open.	Small percentage of humanity maintains **high material wealth, amidst global poverty**.

Governance	Social considerations are absent, so they will **replicate current social relations and working practices**, and **reproduce present racial, class, gender, property, health, and ethnic disparities**.	**Nation-states** based on accountable representative institutions share power with **international organisations** to address local and global sustainability challenges.	**Deliberative democracy innovations** such as citizen assemblies, participatory budgeting, and referendums ensure that **power is equally shared by all citizens**.	Powerful countries use their **economic and military power to secure access to key resources** despite global shortages.
Social welfare		**Welfare states** redistribute excessive inequalities and provide for some basic needs like healthcare and education. **Regulated markets** provision most other goods and services.	Strong **redistributive focus** through **high taxes on wealth** and social justice programmes like **job guarantees**, **universal healthcare and education**, **social housing**, and **UBI**.	Powerful countries maintain **social security for their citizens** through **strict migration controls and protections**.
Work relations		**Capitalist private ownership of corporations** continues but with a **greater voice** to unions, workers, and other stakeholders and a focus on a **triple bottom line** (people, planet, profit).	**Companies belong to workers and communities** rather than private investors and bondholders. **Working time is reduced,** and work-relations are **equal, fair, and democratic**.	**Capitalist private ownership of corporations prevails** and offers some formal employment in powerful capitals. Most **of humanity survives from precarious informal work.**
Culture and worldviews		**Anthropocentric** vision based on liberal vision of **human rights** and **sustainable development** within capitalism.	**Postcapitalist worldview** based on **care, solidarity, and reciprocity** for **human and more than human life** and a deep focus on **socio-ecological well-being** through **conviviality, and radical democracy.**	**Cultural relations remain unchanged,** and **replicate present racial, class, gender, property, health, and ethnic disparities.**
Scientific validity	**Lacks scientific validity** because it assumes that eco-economic decoupling is possible. Projections for increased energy and resource use are thus incompatible with planetary limits.	**Lacks scientific validity** because it assumes that eco-economic decoupling is possible. Projections for increased energy and resource use are thus incompatible with planetary limits.	**Scientifically valid** because it is not based on eco-economic decoupling. It thereby recognises and adapts to planetary boundaries and resource limits.	**Scientifically valid** because it is not based on eco-economic decoupling. It thereby recognises and adapts to planetary boundaries and resource limits.

24.4 Discussion

First and foremost, it is important to note our description of 4 circular futures is an inevitable simplification of complex visions, and its main objective is to help understand the core differences across most circularity discourses to date. Moreover, the actual future of our planet is unpredictable and will depend on how we address present challenges today. **Table 24.1** resumes the key elements of the four described futures to help us compare and contrast their core ideas.

Each of the above discourses has its strengths and weaknesses. RCS and TCE visions place too much hope on sustainable technological innovations to address resource shortages, climate change, and biodiversity collapse. This is clear now that decades of academic research have evidenced that the absolute decoupling of economic growth from environmental degradation cannot occur on a scale sufficient to prevent climate breakdown and biodiversity collapse (Haberl et al. 2020; Hickel and Kallis 2019; Jackson 2016; Parrique et al. 2019; Wiedenhofer et al. 2020).

The idea of perfectly circular resource cycles is simply biophysically impossible. Indeed, materials inevitably degrade and dissipate each time they are cycled. Moreover, in a growing economy, recovered materials can only provide a fraction of our resource needs. More natural resource extraction and environmental degradation will thus remain necessary as long as economic growth continues, so the TCE and RCS visions of a perfect regenerative economy are impossible in the present growth-dependent capitalist system (Genovese and Pansera 2020; Giampietro and Funtowicz 2020).

On the other hand, TCS discourses are perhaps too optimistic about the possibility of transforming current capitalist ways of life, social structures, and power relations in a fair, democratic, and sustainable manner. Envisioning a post-growth society, and thus, a post-capitalist future, does seem like a far shot, especially in a discursive landscape that makes many people believe that “there is no alternative” and think that “it is easier to imagine an end to the world than an end to capitalism” (Fisher 2009). Yet, as Christian Felber puts it, “there are plenty of alternatives" (Felber 2015) thanks to a rich history of social movements and ideas from the GN and South alike that have proposed and enacted radically different ways of living and flourishing (like degrowth, buen vivir, ecological swaraj, steady-state economics, economy for the common good etc.).

On the opposite end of the spectrum, FCE discourses place no hopes neither on technological innovations nor on fair societal transformations. Instead, they rationally, and perhaps cynically, describe the future of humankind and planet Earth if nothing is done to reverse current unsustainable trends. Yet, it is also clear that this is not a world where anyone would like to live, except perhaps some wealthy elites who own crucial technologies and industries and could thus maintain and grow their positions of power.

One thing is certain: we live on a finite and fragile planet with key boundaries and limits, and if we keep overshooting them, the Earth’s climate and ecosystems will inevitably break down and collapse, and critical resources will be exhausted. If we decide to believe in capitalism and the idea that technology can allow us to decouple economic growth from environmental degradation, then we are bound to see crucial planetary functions and ecosystems fail before our eyes. However, if we develop a post-capitalist society that can operate beyond economic growth, then we might have a chance of living in a desirable future that truly leaves no one behind. The real choice is thus not between a TCE, RCS, TCS and FCE society but actually between a TCS and FCE society because those are the only discourses that take the very real material limits of our planet into account.

Thankfully, there are a plurality of circular visions and ideas from the GN and South that have developed a wide range of post-capitalist and post-growth societal visions (and TCS discourses described above are just the tip of the iceberg). They are a breadth of inspiration that can help us overcome the socio-ecological challenges of the 21st century.

Unfortunately, these alternatives are currently not being fully explored as research on CE has found that TCE is currently, by far, the most dominant discourse in public and private institutions (Arai, Calisto Friant, and Vermeulen 2023; Berry et al. 2021; Calisto Friant, Lakerveld, et al. 2022; Calisto Friant et al. 2023; Calisto Friant, Vermeulen, and Salomone 2021; Campbell-Johnston et al. 2020; Melles 2021; Ortega Alvarado et al. 2021; Palm et al. 2021). CE debates and implementation to date have thus not sufficiently addressed the socio-political implications of a circularity transition and the biophysical limits to economic growth. But what would most people prefer when envisioning a circular future?

There is little research on CE perceptions; two recent studies of civil society and citizen perceptions of CE in the EU show that a more holistic and socially inclusive approach to CE is preferred (Lazarevic and Valve 2017; Repo et al. 2018). Three recent surveys also suggest that citizens would prefer TCS discourses. The first survey by the Observatory of Utopic Perspectives in France found that 54.6 % of respondents prefer a sufficiency-oriented and inclusive ecological utopia rather than a growth and technology-oriented neoliberal utopia (15.9%) or a conservative traditionalist utopia (29.5%) (Observatory of Utopic Perspectives 2019). The second survey, by the Global Commons Alliance, found that 74% of people in G20 countries agreed that governments should move beyond focusing on economic growth and profits and instead focus more on human well-being and ecological protection (Gaffney et al. 2021). The third survey found that 60.5 % of people in 34 European countries favour post-growth values such as environmentalism, collectivism and altruism as opposed to neoliberal capitalist values like hierarchy, individualism, and materialism (Paulson and Büchs 2022).

Moreover, a recent survey on CE perceptions around the world by Utrecht University and Revolve Circular found that *holistic* circular society discourses (TCS and RCS) were preferred compared to *segmented* discourses (FCE and TCE) (51.6% vs 48.4%) and that respondents placed a high degree of importance to social justice concerns and consumption/production reduction imperatives (Calisto Friant, Vermeulen, et al. 2022).

The abovementioned research suggests that the *TCE* discourse, which dominates the current debate on circularity, does not align with what citizens would prefer when they are asked to think of a circular future. While these surveys have their limitations, many other studies find that when citizens openly and freely deliberate in a well-informed, inclusive, and democratic environment, they tend to make significantly more sustainable decisions than politicians (Cabannes 2018; Calisto Friant 2019; Dryzek et al. 2019; Fishkin 2018). Research even finds that, in a democratic context, citizens choose to forgo personal gains for the benefit of future generations (Hauser et al. 2014).

A deliberative governance process that hands decision-making power to citizens could help co-design and implement fair and sustainable circularity policies that subordinate economic growth to planetary boundaries and social justice imperatives. This democracy is also needed in the workplace by replacing the hierarchical shareholder capitalism of corporations working to generate endless profits for their stockowners, with non-profit cooperatives owned and managed democratically by workers for the benefit of their socio-ecological communities. Indeed, a more diverse, democratic, and inclusive construction of a circular future is needed to better include the plurality of citizens' discourses and perspectives on circularity.

24.5 Conclusions

This chapter explored 4 CE futures and their key sustainability implications. Our insights suggest that the hegemonic and growth-focused TCE discourse is more a "fairy tale" of technological innovation and competitiveness than a feasible circular transition to all humanity. This TCE future will likely provide many benefits for a few leading businesses, industries, countries, and economic actors but will also most certainly be unable to ensure a dignified life for all humanity and prevent the overshoot of planetary boundaries. In fact, such a future might worsen the unsustainable extraction of natural resources from the GS and could end up exacerbating current patterns of neo-colonial discrimination and exploitation along gender, race, class, and ethnic lines. The TCE vision may have become the hegemonic CE discourse precisely because it ignores these social and political implications. It is hence a depoliticised discourse that seeks to create a CE transition that does not challenge the current growth-dependent capitalist system of endless expansion and commodification of life and nature. In this vision, transition "from linear to circular" simply means better recycling and recovery technologies rather than addressing the systemic causes of our current socio-ecological crisis. It is thus unsurprising that such a discourse gained so much traction in the policy and business arena, as it promised the illusion that a circular flow of materials could allow capitalist economies and businesses to continue growing.

Yet, this TCE discourse is in no way the only vision of a circular future. There are many different circular visions that subordinate economic growth and profits to social and ecological imperatives. We explored these in the FCS future, and as mentioned above, various surveys suggest that citizens actually prefer a more transformative and socially inclusive circularity transition. More inclusive and participatory development of circularity policies, where citizens can openly deliberate and decide on the course of the circularity transition in an informed and democratic manner, would thus likely allow us to overcome current lock-ins and path dependencies. Hence, we must, first and foremost, call for real democracy, one that empowers people through randomly selected citizen councils, non-profit cooperatives, and other institutions that can break powerful interests and lead the way to a socially legitimate and ecologically feasible circularity transition.

More research is needed to gain a better picture of what circularity discourses people find most appealing and what circular economy and society policies they would choose in a democratic context. Further research on circular futures and citizen perspectives and preferences on circularity is hence much needed to help better plan and envision a desirable circular transition that actually brings about improvements in human and planetary well-being. In doing so, our chapter and our illustrations of the four different futures can help visualise the full picture and diversity of circularity visions that exist, with their key differences and commonalities. It can also help imagine a plurality of solutions, practices and policies that can be developed within different circularity approaches. Finally, it can help in transdisciplinary research activities and participatory workshops to define democratic agreements and common visions regarding the shape and type of circularity transition that people can aspire to co-design and co-create.

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JUST2CE
A Just Transition to Circular Economy

Chapter 25. Interfaces of Transformative Innovation Policies, Socio-environmental Justice and Circular Economy: a focus on the Brazilian Semiarid Region

Andrè Mateus Bertolino, Danielle Denes-Santos, Pasquale Marcello Falcone*

Abstract

Transformative Innovation Policies (TIPs) represent a novel approach that links innovation with societal and environmental challenges during the transition towards low-carbon systems. This framework illuminates the interplay between political dynamics and socio-environmental equity, especially in regions marked by resource scarcity and unequal distribution. A prime example is Brazilian semi-arid area, characterized by resource limitations leading to unhealthy practices like using hazardous firewood for cooking. The Biodigestor Sertanejo Program, a result of collaboration among the Brazilian Government, the UN's International Fund for Agricultural Development (IFAD), and the Global Environment Facility (GEF), has been operational since 2008 to promote sustainable production in this region. This research focuses on this initiative, leveraging TIPs, social/environmental justice, and circular economy literature to analyse policy documents. Through assessing intervention goals and project execution data, the study aims to gauge the efficacy of the program in providing technological innovation access, fostering stakeholder engagement, and ensuring a socially and environmentally equitable transition.

Keywords: Transformative Innovation Policies; Justice; Circular Economy, Sertanejo Biodigestor Program

The Chapter addresses the issue of inadequate access to essential resources in the Brazilian semi-arid region, causing precarious living conditions. TIPs are proposed to connect innovation with social and environmental challenges, aiming for an equitable transition to sustainable low-carbon systems within the framework of CE.

25.1 Introduction

In recent years, the circular economy (CE) concept has gained popularity as an effective way to reduce the harmful impact of linear economic models on the environment (Stahel, 2016, Kirchherr et al., 2017; Geissdoerfer et al., 2017). However, although the CE model is widely considered to be a response to ecological issues, some have pointed out its failure to consider the social consequences of this model (Padilla-Rivera et al., 2021). The social implications of CE models have received insufficient attention, perhaps due to a lack of conceptual clarity (Mies and Gold, 2021). This indicates that there is an emphasis on the productive aspects of the economy, which has given rise to many criticisms of the CE model (Kopnina, 2019; Temesgen et al., 2021). The CE has great potential to address environmental concerns, but is sometimes negligent in the social pillar (Blomsma & Brennan, 2017). Thus, it is necessary to develop discussions committed to evaluating the social ramifications of the CE model that addresses social challenges. Against this background, the research is framed within the multidimensional framework proposed by the JUST2CE project, emphasizing the need for a comprehensive evaluation of the CE transition. The framework comprises four key dimensions: framing, vulnerability, distribution, and learning. Framing involves understanding how different actors interpret and shape the CE transition, while vulnerability delves into the social and epistemic injustices present within CE discourse. Distribution examines the geographic and social inequalities associated with CE policies, while learning emphasizes the importance of participatory approaches and reflexivity in knowledge production. These dimensions are interconnected, promoting a holistic understanding of the complexities of the CE transition. The framework encourages a critical examination of power dynamics, marginalized voices, and global inequalities within the context of the CE implementation. Inserted in the CE dynamics is biogas. Biogas production is an excellent approach that helps reduce waste and mitigate greenhouse gas emissions, showing the use of a CE model (Wang et al., 2021). In the Brazilian scenario, CE is seen very positively in contexts of scarce resources, as is the case of the Semiarid Region. It is a region that faces serious socioeconomic difficulties, such as poverty, limited economic diversity and lack of access to safe ways of cooking. These challenges significantly limit income generation and employment prospects for communities in the region (IPEA. 2019). Biogas has been seen as an alternative to face the environmental, social and economic challenges that developing regions are subject to (Diouf & Miezan, 2019). Committed to contributing to this problem, the Sertanejo Biodigestor Program seeks to promote this form of energy as a solution to social issues in the Brazilian semi-arid region. This biogas promotion policy serves as an excellent approach to a CE, since, through the use of biodigester technology, rural organic waste is treated for the production of cooking gas and fertilizers (Silva & Correia, 2020).

This research aims to evaluate the effectiveness of the Sertanejo Biodigestor Program in promoting access to technological innovation, with attention to the dimensions of distribution, participation and recognition of EJ (EJ).

Thus, this study seeks answers to the following research question: *How can the Sertanejo Biodigestor Program be evaluated in relation to its strengths and weaknesses considering the dimensions of distribution, participation and recognition of Environmental Justice?* By analysing the connection between energy justice and transformative innovation policies from a case study, this research can help public policies and initiatives committed to ensuring an equitable and sustainable transformation in rural areas. By pointing out the challenges and opportunities of this policy, this study also sheds light on the prospects for promoting social and EJ in the promotion of biogas in a context marked by major environmental, economic and social problems.

25.2 Literature review

25.2.1 EJ and its dimensions

The distribution of natural resources has been widely discussed in recent years, as it relates to the production or intensification of inequalities. The displacement of environmentally harmful activities in GS regions and the resulting "ecological debt" has triggered significant environmental distribution conflicts as highlighted by EJ advocates and scholars (Hornborg and Martinez-Alier, 2016; Martinez-Alier, 2021; Scheidel et al., 2018). These disparities necessitate acknowledgment and response within the frameworks of CE underscoring the importance of addressing global structural asymmetries. Apart from the geographical allocation of burdens and benefits, the concept of "justice" entails ensuring equitable access to resources and opportunities to rectify inequalities and vulnerability (Barca, 2020). Committed to discussing these disparities, EJ has increasingly approached complex dimensions of the social sphere (El Amrani, 2021; Lessmann & Steinkraus, 2019). The focus of EJ, in general, is on highlighting the environmental burden and lack of access to decision-making of economically, socially and politically marginalized communities (Pellow, 2021). In view of this, EJ is indicated as a promising approach to investigate aspects related to the development of the CE, with emphasis on the social dimension of these processes (Menton et al., 2020). Sustainable Development (SD) is increasingly linked to EJ (Schlosberg et al., 2019). Social justice, economic well-being and environmental management are interdependent dimensions so the EJ and the SD act from this discussion in the direction of revealing problems and finding solutions for the unequal distribution of natural resources and for the way in which this dynamic generates social marginalization in the context of environmental exploitation (Pellow, 2021). The questions mentioned above arise from the recognition that if not handled fairly, transitions towards sustainability (considering all dimensions) have the potential to impose unwarranted challenges on workers and their communities, potentially resulting in resistance that could impede the successful execution of required actions. From this standpoint, the concept of a "just transition," originating from the labor movement, takes on significant importance. Brian Kohler, a Canadian labor member, encapsulated this concept back in 1966 when he asserted, "*The real choice is not jobs or the environment. It is both or neither*." This statement succinctly captures the essence of the just transition idea, which remains highly relevant in our current era marked by profound political polarization and the tension between employment and environmental concerns (Eisenberg, 2019).

Schlosberg's EJ theory (2004) contributes to the reflection on this theme, as it identifies three key issues to be observed: *distribution*, *participation,* and *recognition*. *Distribution* refers to the allocation of material goods and rights/duties among the members of society. *Participation* is related to decision-making, referring mainly to understanding how opportunities for participation by communities and individuals are made possible to demand EJ and equity in the distribution of environmental impacts. Finally, *recognition* refers to the inclusion of all subgroups in a society in any attempt at development and the explanation of how the most privileged groups achieved this status and why. Furthermore, it involves valuing cultural diversity and respecting the unique perspectives and experiences of affected communities. Schlosberg's structure (2004) can help answer the main criticisms of CE pointed out by the current literature. By bringing EJ into CE policies, weaker groups, such as precarious workers, would engage in the social and economic policies to be applied and the subgroups of a society, which should be included in any attempt at development. Known as the tripartite EJ framework, this theory provides a holistic and intersectional approach to understanding and addressing issues of EJ. Thus, it is recognized that EJ is not restricted to the distribution of environmental risks and benefits, but also involves complex issues of recognition and participation, essential to ensure equitable and sustainable environmental outcomes for all. By including EJ in CE policies, it is possible for policies to walk in fairer, more equitable and sustainable ways in relation to their impacts on people and communities. Thus, EJ is also increasingly linked to SD principles, as the social dimension is critical to ensure that a society is sustainable in environmental and economic terms.

25.2.2 Transformative Innovation Policies (TIPs) and their interfaces towards EJ and CE

The search for EJ has been one of the main demands of civil society, especially those communities that disproportionately suffer the negative effects of environmental imbalance (Liotta et al., 2020). In this context, it is important to understand how political and economic paradigms relate to the issue of EJ and how innovation policies can contribute to a more inclusive and sustainable approach. The political paradigm of TIPs has proven to be an alternative to deal with the current crises, by connecting innovation with social challenges and transformative changes, opening a new discursive space for discussions and policy advances (Diercks et al., 2019). The emphasis on the interactive nature of innovation allows bringing together different parts of the system for the development of innovation, including companies, cities, communities and organizations that can contribute to sustainable transitions (Geels, 2020). TIPs also aim to address failures in policy coordination and reflexivity that often impede the effectiveness of innovation policies. Failure to coordinate policies refers to the inability to horizontally coordinate policies in different domains, such as environmental policies, fiscal policies, economic, social and employment policies, which can generate inequalities and negative impacts on vulnerable communities (Akon-Yamga et al., 2021). These discussions point out that EJ involves social issues that must be included in the political agendas of innovation and technology. This means ensuring that innovation policies are inclusive and consider the needs of historically marginalized communities and social groups. Furthermore, it is important to consider that technological solutions are not enough to address issues of EJ. As Bullard (2021) points out, EJ requires a holistic and interdisciplinary approach that considers the social, cultural and political dimensions of environmental problems. This implies listening to and involving affected communities in political decisions and the construction of sustainable and inclusive solutions. The emergence of this new political paradigm, focused on connecting innovation with social and environmental challenges, points to the need for new solutions to deal with the current crises and for a more inclusive policy that involves different actors and considers different dimensions. In this context, the TIPs approach seeks to address flaws such as directionality, policy coordination, articulation of reflexivity and geographic dimensions, seeking to promote a transition to more sustainable practices. TIPs propose an innovative approach to deal with social and environmental challenges, through the connection between innovation and transformative changes. TIPs consider innovation as an interactive and social process, involving different stakeholders, including companies, cities, communities and organizations. TIPs thus aim to create an environment conducive to innovation and systemic changes that can lead to sustainable and inclusive transitions (Schot & Kanger, 2018). It is important to remember that this approach argues that an emphasis on the interactive nature of innovation allows the connection between different parts of the system for the development of innovation (Geels, 2020; Diercks et al., 2019). The approach of the TIPs is important for the discussion on EJ, since it considers the inclusion of different actors and the concern with the social and environmental dimensions in the innovation policy.

In this study, we examine TIPs and their role in disseminating this technology as a strategy to drive and enhance the adoption of biogas technology in Brazil. Therefore, by adopting the perspective of TIPs to analyze this case, we recognize that this initiative goes beyond simple technology promotion but encompasses systemic changes, addressing economic, institutional, and social challenges to drive the adoption and positive impacts of biogas technology in small rural properties in the Brazilian semiarid region.

25.3 Materials and Methods

In this section, the methodological aspects related to the analysis of the Sertanejo Biodigestor Program will be presented from the participation, recognition and distribution dimensions of Schlosberg's theory (2004) on EJ.

25.3.1 Case Study

The Biodigestor Sertanejo Program is a social initiative that aims to contribute to the sustainable development of the Brazilian semi-arid region (Carvalho & Lago, 2020). Although the first biodigesters of the Program were delivered in 2009, this social technology has reached a larger number of families in recent years, through a biogas production system from rural waste, used as a source of energy to cook food and as a fertilizer that spread throughout Brazil. The Program is part of a larger project known as Dom Helder Câmara. The project is funded by the International Foundation for Agricultural Development (FIDA) and the Brazilian government, the initiative developed actions with around 54,000 families from 913 municipalities that live in the Brazilian semi-arid region by offering technical assistance and social promotion, coordinating and implementing actions that seek to training to improve income and promoting economic, social and organizational autonomy (Barros et al., 2020).

Figure 25.1 show that the low-cost sertanejo biodigester is a simple system that uses the anaerobic decomposition of organic waste to produce biogas. Approximately 2,000 biodigesters have already been constructed, and additional projects are in progress to further disseminate this technology in the region, thousands of people to benefit from it. Installed close to sources of organic waste, such as animal manure and food waste, the technology consists of an excavated pit lined with impermeable materials. It consists of four boxes: inlet box, fermentation box, gas storage tank and outlet box. Organic waste is added through an inlet and undergoes anaerobic fermentation inside the biodigester, resulting in the production of biogas, which is used by households for cooking, while its effluent can be used as organic fertilizer (Mattos & Farias, 2011).

Figure 25.1 Sertanejo biodigester built in the Brazilian semi-arid region. Source: Mattos & Farias (2011)

The socioeconomic vulnerability of the rural population in the northeastern semi-arid region has intensified due to successive increases in the value of cooking gas derived from oil. For these reasons, the population has more frequently used firewood and/or charcoal to cook food, even though this practice involves serious risks to the health and safety of these communities (Gioda, 2019).The Biodigestor Sertanejo Program is, therefore, one of the social technologies supported by the Dom Helder Câmara Project that contributes to the generation of clean and renewable energy in rural communities in the semi-arid region, reducing dependence on fossil fuels and improving the quality of life of local families (Barros et al., 2020).

The Biodigestor Sertanejo was implemented in several communities in the Brazilian semi-arid region with the aim of contributing to improving people's quality of life and preserving the environment (Calgaro Neto & Souza de Oliveira, 2022). The semi-arid region is characterized by long periods of drought, scarcity of water resources and low soil fertility. These conditions make food production difficult and make the lives of residents of the region quite challenging (Silva et al., 2019). The Brazilian semiarid occupies 12% of the national territory and is home to around 28 million inhabitants divided between urban (62%) and rural (38%) areas (**Figure 25.2**). Therefore, it is one of the most populated semi-arid regions in the world (INSA, 2022). Almost 80% of all rural establishments present in the Brazilian semi-arid region are characterized as family farming, which corresponds to 37.1% of the segment in Brazil (IBGE, 2017). More than half (59.1%) of Brazilians living in extreme poverty live in this region, which also has lower human development indices, which take into account indicators of longevity, education and income (SUDENE, 2021).

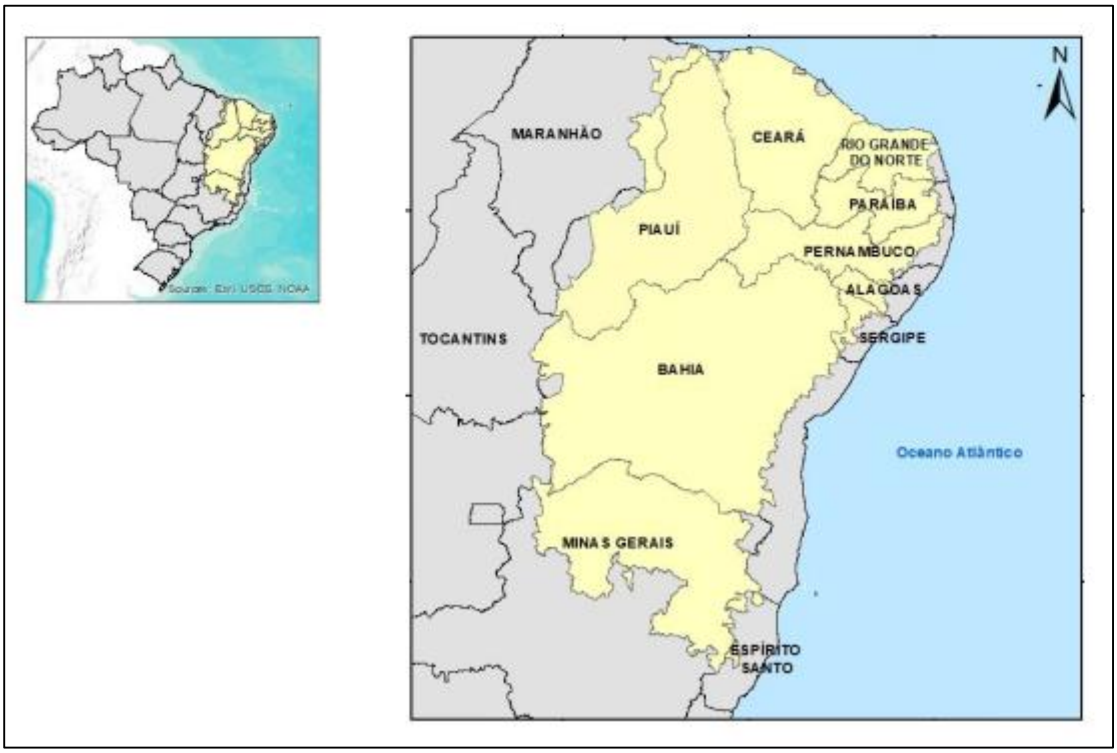

Figure 25.2 Brazilian Semiarid Map. Source: SUDENE (2021)

The municipalities that make up the Brazilian semi-arid region have a hot and dry climate and an economy based mainly on family farming (Bezerra et al., 2020). The Sertanejo Biodigestor Program was applied in rural communities in the Brazilian semi-arid region due to the challenges faced by the region. Geographic characteristics and difficulties in accessing clean and renewable energy sources are some of the main problems that rural communities in the semi-arid region have to live with. For this reason, policy makers saw the Sertanejo Biodigestor Project as a viable and sustainable alternative for generating clean and renewable energy, which can be produced from rural waste, resources that are abundant on family farms.

In addition, 75% of rural households in the region do not have an adequate treatment or disposal system for sewage which, in general, is dumped into rudimentary pits, ditches, or directly into the ground, or into streams, rivers or lakes (IBGE, 2017). These problems represent a serious public health and environmental problem, since improperly treated sewage can contaminate the soil, groundwater, rivers and lakes, in addition to increasing the risk of diseases.

25.3.2 Data collection and analysis

In our exploratory study, we used a qualitative data analysis approach through a case study to reach an understanding of the weaknesses and strengths of the initiative characterized by the Sertanejo Biodigestor Program based on the dimensions of Schlosberg's (2004) tripartite approach to EJ. We compiled relevant literature and examined published documents, including scientific articles, reports, theses and dissertations, video content from social networks, and materials produced by the government, civil society organizations, and the media about the Program's work. Data were categorized with specific descriptions and active searches were carried out for strengths and weaknesses, experiences, stakeholders, policy decisions and important events that related to the Program. This process involved several detailed readings of the texts to identify themes based on Schlosberg's (2004) conceptual framework for EJ.

Based on what the author proposes about approaching the dimensions of recognition, distribution and participation, we seek to understand how politics seeks to intervene in these questions of justice. Using EJ's tripartite structure, we defined categories of analysis based on Schlosberg's (2004) proposal in a systematic and organized way through the elaboration of a matrix (see **Table 25.1**) that relates the criteria to the dimensions of recognition, distribution and participation.

Table 25.1 Analysis dimensions based on Schlosberg's criteria (2004)

Dimension	Aspects analyzed
Participation	1. Involvement and active participation of local residents in the program implementation process. 2. Conducting training and technical assistance actions for local communities. 3. Existence of reports of positive impacts on the quality of life of local residents arising from the implementation of the program.
Recognition	4. Respect and appreciation of local culture and traditions by the Sertanejo Biodigestor Program. 5. Existence of dialogue and negotiation with local communities to identify their needs and demands. 6. Consideration of local residents as partners in the program implementation process.
Distribution	1. Promotion of equitable distribution of benefits generated by the program. 2. Fair and equitable distribution of benefits generated by the program among local communities. 3. Seeks to reduce socioeconomic inequalities and promote sustainable development in the region.

Source: The authors based on Schlosberg (2004)

We chose papers based on their alignment with our research objective. Searches in the databases took place on 04/05/2023. We searched for the terms "Biodigest*r Sertanejo and Semiarid" and "Biodigestor Sertanejo and Semiárido" (in order to gather texts written both in Portuguese and in English) in the Scopus, Web of Science, Google Scholar and Periódicos Capes databases to raise academic publications that explored dimensions of this policy. In order to access news published by the media and by civil society organizations, a more extensive search was carried out in the Google search engine with the filter "news", from the same term. We also searched for content published on the Government of Brazil website to access policy documents. We also conducted a survey on the YouTube social network, where civil society organizations, government and universities produced videos with content about the Program.

We did not make time restrictions in our searches and we chose to consider documents published since the beginning of the Program's activities. We included 19 documents (9 academic studies and 10 documents from civil society organizations) during the analysis, using the Snowball technique, as recommended by Biernaki and Wandorf (1981), due to the potential that these texts had to support the study.

In the end, we obtained a result of 159 documents, however some exclusions were made, either due to identified repetitions (12) or because the contributions were not useful for our investigation (64). Our content analysis, therefore, was performed from 95 documents. Information on searches is systematized in **Table 25.2**.

Table 25.2 Search mechanisms and number of documents

Document source	Amount	Excluded	Total
Academic studies			
Web of Science	1	0	1
Scopus	0	0	0
Capes periodicals	3	1	0
Google Scholar	40	9	31
Added by the snowball technique	9	0	15
Repeated	-	12	0
News, Reports and Videos			
Google search engine	36	12	28
Videos	15	7	8
Government Website	45	23	22
Added by the snowball technique	10	0	10
Total partial	96	42	54
Total	159	64	**95**

Source: authors'elaboration

Documentary research based on the analysis matrix that considered Schlosberg's tripartite structure provided important subsidies for the analysis of the Sertanejo Biodigestor Project. The adoption of systematic and organized criteria presented in Table 1 allowed a more rigorous and reliable analysis of the social impacts in which the project intends to intervene.

25.4 Results and discussions

In this section, we present the results and discussions of the documentary analysis carried out on the Sertanejo Biodigestor Program, from the perspective of EJ. By evaluating the dimensions of participation, distribution and recognition, we seek to understand how the program has been implemented and what socio-environmental impacts have been generated for farming families in the Brazilian semi-arid region.

25.4.1 Scientific literature

In this analysis, we evaluate the participation, recognition and distribution of the Program's actions explored in the academic literature published in the searched databases. The literature review pointed out that one of the fundamental criteria for the success of a community program is the participation and active involvement of local residents. Regarding the Sertanejo Biodigestor Program, several articles highlight the involvement of the community in the implementation of actions (De Souza et al., 2021) in which initiatives were identified that enabled a participatory process of building the program. Queiroz (2015) and Barros et al. (2021) explore the mobilization of community leaders and local associations with the implementation of the Program, which contributed to the dissemination of technologies and the training of residents. In addition, another important criterion is the carrying out of training and technical assistance actions for local communities. In this regard, several studies point to the importance of the qualifications and training offered by the Sertanejo Biodigestor Program. For example, the study by Gama et al. (2018) highlights that technical training was fundamental for the autonomy of communities in the management of biodigestors, in addition to generating income and improving the quality of life of residents Silva and Correia, 2020; Barros et al., 2021). Finally, another important criterion is the existence of reports of positive impacts on the quality of life of local residents resulting from the implementation of the Program. Several articles highlight the benefits generated by the Sertanejo Biodigestor Program, such as reducing environmental impacts, improving public health and generating employment and income (Bezerra et al, 2020; Santos, 2023; Salzer, 2018 and Gama, 2018). The recognition and appreciation of local culture and traditions are fundamental aspects for the success of community programs. Gama (2018) highlighted the importance of considering the local culture. As for the criterion characterized by the existence of dialogue and negotiation with local communities to identify their needs and demands, in the academic studies analyzed, reports of dialogue actions with local communities to understand their needs and demands before the implementation of the Program were not identified, only during the implantation of the biodigester and after. This proves to be a bottleneck for the initiative, as knowledge of the needs of communities in terms of waste treatment and the choice of the most appropriate technologies for each location is important for the effectiveness of the policy. Equitable distribution of benefits generated by the program is an important criterion for ensuring social justice and promoting sustainable development in the region. Several studies highlight the importance of promoting the equitable distribution of benefits generated by the program, as pointed out by Barros et. al (2020) and Calgaro Neto & Souza de Oliveira (2022) when highlighting that the Biodigestor Sertanejo Program contributes to the social inclusion of the community. In addition, these studies indicated that the implementation of the program promoted the reduction of environmental impacts, improvements in public health and in the quality of life of local residents. In general, it is possible to state that the analyzed literature also highlighted that the Sertanejo Biodigestor Program promoted actions in the dimensions of participation, distribution and recognition.

25.4.2 Analysis of news, reports and videos

Based on the analyzes carried out on the news published about the Biodigestor Sertanejo Program, it is possible to verify that the dimension of recognition of the JE has been contemplated in a significant way. The news, in general, highlight the importance of the program for the generation of clean energy and organic fertilizer in rural communities in the Brazilian semi-arid region, highlighting the adaptation of technology to local conditions and sertaneja culture (Renova Semiárido, 2020; Aberje, 2018). However, regarding the dimension of participation, the news has some limitations, as had already been observed in the analysis of academic productions. Although the documents highlight that farmers contributed to the construction and operation of biodigesters (IFRN, 2013 FBB, 2015, UFPB, 2022), none mentioned community participation in the decision-making process, nor in defining the best technology or choosing of the criteria that determined who would benefit from the Program. This may indicate a limitation in the engagement of different sectors of the community and compromise the sustainability and effectiveness of the program. Regarding the distribution dimension, the news presents some challenges. Although they all highlight the economic and environmental benefits of technology for rural communities in the Brazilian semi-arid region, no mention was made of the measures adopted to ensure the equitable distribution of environmental and social benefits and burdens among the different social groups involved. This limitation may indicate the need to improve the policy for distributing the benefits generated by the program. Schlosberg (2004) points out that a common problem in many rural communities is the lack of recognition of traditional knowledge and practices in relation to agriculture and environmental management. This was a positive point observed during the content analysis of the documents, there is mention of initiatives related to the Program that seek to value and strengthen these practices, including meetings of farmers that promote the exchange of experiences between different rural communities. Regarding the dimension of participation, another common problem in many rural communities is the lack of effective engagement in decision-making processes related to the management of natural resources and the implementation of public policies. Several analyzed texts mention projects and initiatives that seek to increase the participation of rural communities in these areas such as water management actions carried out, including by women in the region (Governo de Sergipe, 2021).

In addition to news, various actions and dimensions of the Program were explored through content published by the government and civil society organizations, either through reports, opinions or through content published on the YouTube social network. Analysis of these documents provided important information about how the program is being implemented and what its implications are for EJ. The analysis of the Biodigestor Sertanejo videos identified three recurring themes: i) the collaboration between rural producers and the program team, ii) the reduction of poverty and iii) the contribution to sustainable rural development, and the installation and maintenance of biodigestors by rural producers. These documents showed that the collaboration between rural producers and the Biodigestor Sertanejo team is crucial to the success of the program, but that it is not always possible to make this interaction viable (Diaconia, 2016; LATACS TV, 2021).

There are videos that point out that rural producers are encouraged to collaborate with the program, either through the installation of biodigesters or by publicizing the program to other rural producers, a concern that converges with the distributive dimension of JA, which seeks equity in the distribution of environmental benefits and respective risks (Diaconia, 2014; Experimentador do Sertão, 2022). In this sense, the dimensions of the EJ can be seen as useful analytical tools to assess whether a sustainable development project or program is fair or not.

Analyzing these dimensions can help identify whether environmental benefits and costs are equitably distributed across different social groups, whether there is adequate participation and inclusion of affected communities in environmental decisions, and whether cultural identities are valued and recognized. In the case of the Sertanejo Biodigestor Program, the distribution of benefits is highlighted in several analyzed documents. In addition, the documents point out that the savings provided by the use of biodigesters generated extra income for the family, including cases in which families began to receive extra income from the sale of food products provided by the ease of access to gas for cooking or commercialization. of organic fertilizers produced by the biodigester on its own properties.

The reduction of cooking gas costs and the production of biofertilizers were pointed out as the greatest benefits of the program (Diaconia, 2016). Although the analyzed documents demonstrate distributional and participation concerns, there is little evidence of concern with the recognition dimension. This can be attributed to the limited nature of these documents, which generally focus on technical and practical aspects. However, the lack of attention to the recognition dimension is problematic because it neglects the cultural and social aspects of the communities involved in the program.

25.4.3 Strengths and Weaknesses of the Sertanejo Biodigestor Program in terms of TIPs

The Biodigestor Sertanejo Program has contributed to the promotion of sustainable technologies in the Brazilian semi-arid region, with the main objective of producing renewable energy and reducing the environmental impacts caused by the use of fossil fuels. However, like any program or public policy, Biodigestor Sertanejo has strengths and weaknesses that must be considered when assessing its impact on the communities and social groups involved. In the distribution dimension, we observe how the analyzed documents seek to present a positive image of biodigesters, emphasizing their environmental and economic benefits. However, there is no critical reflection on the limitations and challenges of using biodigesters, such as obstacles to the need for technical and financial training of farmers and dependence on transport and logistics infrastructure for the use of biogas. There also does not seem to be an effective concern with cases in which the family stops using the biodigester. The analyzes allow us to perceive a constant movement of ratification of the positive side of the Program and the way in which the initiative can contribute to the reduction of energy and input costs, with emphasis on the potential economic benefits for farmers. However, there is no critical reflection on how the use of biodigesters can reinforce farmers' dependence on institutions or companies that provide technologies for biogas production, for example, or on specialized technical assistance to operate. This dimension of Schlosberg's model is a point of attention, since, even if social technologies are important to ensure that aspects of justice are observed, they can maintain the unequal distribution of power and resources between different social groups. Power is a crucial aspect of EJ, as marginalized communities are often relegated to opportunities to participate in decision-making processes that directly affect their own lives. In the case of the Sertanejo Biodigestor Program, it is important to examine in future research whether these power relations are producing or maintaining injustices. The videos and news reviewed often feature technical experts explaining biodigester technology and how it works. While this information is important, it is also important to ensure that the voices of project-affected communities are heard and that they have a say in how the project is implemented. In general, although the full participation of the community in the stages that precede the implementation of the Project has not been identified, the active participation of local residents in the process of implanting the biodigester, carrying out training actions and technical assistance for local communities were identified in reports of positive impacts on the quality of life of farmers and demonstrate the Program's commitment to promoting sustainable development in the region. The analysis of the documents pointed out that the events in which the appreciation of the local culture is mentioned is not enough to guarantee the full approach of the dimension of recognition of the JE. The posture of the government and the organizations involved in relation to the dimension of recognition of the EJ could be more robust, for example, in proposing broader partnerships with local cultural groups. The continuity of the program should consider maintaining these relationships and promoting the equitable distribution of benefits to local communities, thus ensuring its long-term sustainability. Finally, it is necessary to highlight the importance of cooperation between different actors and institutions involved in the program, including civil society organizations, universities, research institutions and government agencies. Collaboration between these different actors can contribute to identifying innovative solutions and improving the program, in addition to strengthening the articulation and support network for male and female farmers.

25.5 Conclusions

The Biodigestor Sertanejo Program is an important initiative in the search for sustainable solutions for the environmental and social problems of the Brazilian semi-arid region. By providing an alternative for producing clean energy from organic waste, the program promotes EJ by acting directly to reduce the negative environmental impact and improve the living conditions of rural populations. The Sertanejo Biodigestor Program has made efforts to involve farmers and their families in the process of implementing biodigestors, promoting training and offering technical assistance. However, there are still limitations on how farmers' participation is effectively incorporated into the program, especially in terms of decision-making and priority setting, that is, in the steps that precede technology deployment. It was identified that the program has the potential to contribute to the reduction of socioeconomic inequalities in the region, providing a source of renewable energy and financial savings for family farmers. However, there is a need to assess more broadly how the program is being distributed geographically and across different socioeconomic or gender and racial groups to ensure that inequalities are not perpetuated or even exacerbated. Finally, in the recognition dimension, the program demonstrates a limitation in recognizing and valuing cultural diversity and the identities of the communities involved. A greater effort is needed to ensure that the approaches adopted in the program are sensitive to cultural differences and respect local specificities, so that the program is truly inclusive and sustainable. Thus, it is important that the Sertanejo Biodigestor Program promote more robust actions to strengthen the recognition dimension, through consultation and involvement of local communities in the design and implementation of the program, valuing their traditional practices and knowledge, and promoting gender equity. and social inclusion. Only then will it be possible to ensure that the program is effectively transformative and sustainable in the long term. An important limitation of this study to be mentioned is that the documents may not have been able to provide an in-depth understanding about the Program, due to its scope and complexity. At the same time that this is imposed as a limitation, it also reinforces the recommendation for future research that strives to expand this study, for example, through interviews, so that other points of view are explored in the context of this policy.

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pratico-para-construcao-de-biodigestor-sertanejo-ccen-ufpb#:~:text=O%20projeto%20'Ecofossas'%2C%20coordenado,canal%20do%20projeto%20no%20Instagram.

Chapter 26. Participation Beyond Statements: Some Critical Considerations about Inner Cilento, Italy

Serena Kaiser, Chiara Vassillo

Abstract

Italy has adopted several initiatives for the engagement of the different stakeholders, within the framework of Circular Economy oriented policies. Italian inner areas have recently been very much focused by both Italian and European institutions, and many funds and initiatives have been dedicated to these territories. The aim of this chapter is to evaluate two participation initiatives in a specific territory of Campania Region, inner Cilento, to examine whether they are building empowering experiences for local communities or not. The first one is a bottom-up initiative, the MAI (Meeting Aree Interne – Inner Areas Meeting); the second one is a top-down initiative organized by a local municipality to create a connection between the interested subjects and European calls for agrivoltaic projects of local energy production. Therefore, the study's main purpose is to provide a reading guide for territorial participation initiatives, in order to define their real empowering potential for local communities and to what extent they can encourage a just transition from linear economy towards a circular model.

Keywords: Participation; Local Communities; Inner Cilento; Territories; Just Transition.

With the aim of providing suggestions for decision makers, this chapter analyses some participation experiments in the inner Cilento territory, Campania Region, comparing the practice to the political intentions included in the strategic documents dedicated to participation

26.1 Introduction

The centrality of participation measures towards Circular Economy has been recognized by a joint initiative of European Commission and the European Economic and Social Committee (EESC) that, in 2017, created the European Circular Economy Stakeholder Platform (ECESP)[45], in order to guarantee that the actors of civil society play a role in the transition. In Italy, the National Plan on Sustainable Production and Consumption[46] (foreseen by the Law 221/2015[47]), only includes people in the operational area called "Consumption and Sustainable Behaviours". This means that they are mainly considered as consumers and that the approach consists in emphasizing individual behaviours and responsibility instead of collective organization. On the other hand, recent initiatives of implementation and revision of the National Strategy for Sustainable Development[48] include, at least formally, the concept of territorialization, which suggests that the individual/consumption oriented/behavioural dimension should not be the only one to conceive participation. Italy's inner areas have recently been very much focused both by European and national institutions, and many funds and initiatives are dedicated to these territories.

According to Pansera, Genovese and Ripa (2021), however, the so called "ecological transition", together with the transition towards Circular Economy (CE) is often presented as a merely technological issue, thus neglecting social and political aspects which deal with discrimination, participation, social and environmental justice, among the others[49]. Reducing the matter to a simple necessity to create new products which can be considered adequate to be labelled as "circular" may lead to an unchanged neoliberal market where profit is still the rationale but the goal becomes that of selling labelled products. Furthermore, this technocratic option might also produce a rebound effect[50].

[45] https://circulareconomy.europa.eu/platform/en
[46] It is important to highlight that a draft of this plan has been created in 2008 and revised in 2013. After this, the 2015 law which is mentioned below foresees a definitive plan, but it is still unaccomplished. From the 2008 and 2013 drafts and from the aim of the law's article 21, it is possible to outline what is said here. See also https://www.mase.gov.it/pagina/la-strategia-europea-consumo-e-produzione-sostenibili#:~:text=Piano%20d%E2%80%99azione%20nazionale%20su%20Consumo%20e%20Produzione%20Sostenibili,Strategia%20Nazionale%20per%20il%20Consumo%20e%20Produzione%20Sostenibile
[47] https://www.gazzettaufficiale.it/eli/id/2016/1/18/16G00006/sg
[48] https://www.mase.gov.it/sites/default/files/archivio/allegati/sviluppo_sostenibile/SNSvS_2022.pdf
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[50] Ibid.

Building upon the above insight, this chapter looks at the initiatives that are promoted within rural contexts, and particularly at two specific cases, to investigate whether they represent techno-oriented policies or an authentic way to widen the participation of local communities.

Many initiatives are detectable in the territory of inner Cilento in the fields of environmental preservation, social promotion, just ecological transition, circular economy and sustainability, especially within the agri-food and tourism sectors. This is true both from the institutional side and the world of local associations. For this reason, it is possible to investigate both top down and bottom-up initiatives[51].

During the period spent on the territory, many circularity experiments have been detected, especially in the agri-food sector. Many of them are driven by young people (under 30) who had been living and working abroad or in other Italian cities, before the COVID pandemic started. Their stories have been collected during a six-month period (and several other brief periods after that) spent through the territories of Laurino, Sacco, Valle dell'Angelo and Roccadaspide. These young people were mainly employed in gastronomy and hospitality-related jobs: this means that all of them had problems when this kind of activities had to be closed due to the several lock downs; some of them also ended up losing their jobs.

Having to choose what to do in that difficult situation, many of them decided to go back to their hometowns for two main reasons: a) the possibility to stay safe from the sanitary point of view (small towns were incomparably safer than big cities during the COVID pandemic, due to their isolated positions and the scarcity of people's movements); b) the loss of their own salary, because of which they were not able to afford urban living.

This might appear as a big fracture in a young person's life; however, many of these young people created new job opportunities for themselves and their communities, thus changing the destiny of some family businesses settled in inner Cilento.

In order to create the possibility for this phaenomenon to change the trend of depopulation in inner areas, the participation of local communities in local public life – particularly of the youngest component – becomes crucial. Indeed, a recent study developed by the association "Riabitare l'Italia" in collaboration with the University of Torino and several other research entities has revealed that young people from the inner areas of southern Italy have a peculiarity in terms of wishing to stay or to leave, compared to similar sample-groups from central and northern Italy: they are characterized by the pattern "wishing to stay but believing not to be able to stay" (Mazzocchi et al., 2022)[52]. As it is possible to see in the results and discussion section, this observation seems to be confirmed by

[51] Spending time on the territory is always the best option to have information about local initiatives, but some web-sites giving local news can be helpful, like for example https://www.sentieridelbuonvivere.it/gal/.

[52] Mazzocchi, G., Barbera, F., Bochicchio, D., Cersosimo, D., Cutello, G., Leone, S., Lucatelli, S., Membretti, A., Orio, A., Scotti, M., Sonzogno, G., Storti, D., Tomnyuk, V., Urso, G., 2022, Giovani Dentro. Uno sguardo alle prospettive e ai bisogni dei giovani delle aree interne, Publisher: Riabitare l'Italia.

both the topics engaged by the organizers and the feedback collected among the participants during the MAI-Lab (Laboratorio del Meeting Aree Interne – Inner Areas Meeting Laboratory), performed in Valle dell'Angelo the 1st of July 2023.

26.2 Materials and Methods

As it is possible to read on the dedicated website[53], the "Inner Areas National Strategy" ("Strategia Nazionale Aree Interne" – SNAI) is an Italian national plan aimed at developing projects and actions to intervene on the difficult situation of 1077 municipalities, divided into 72 "project areas" (official denomination) and including about 2.072.718 inhabitants. Taken together, these areas represent 60% of the whole national territory and the 52% of Italian municipalities, but only the 22% of the population, due to the well-known phaenomenon of depopulation in inner areas, sometimes described as a "demographic bleeding".
A territory is classified as "inner area" when it falls within the boundaries of the "intermediate", "peripheral" or "ultraperipheral" area in terms of distance from the "poles", which are the municipalities where the three main typologies of services – health, education and mobility – are concentrated[54].
The selection of the territories to be classified as "inner" has started in 2013 and, from the financial point of view, two national laws – the Stability Law of 2014 and the Budget Law of 2018 – comprehensively allocated 281,2 million euros for the implementation of the SNAI. These funds have been destined to services (school, health and mobility) in the selected areas. In addition to these funds, the regional institutions also dedicated economic resources from the co-financed programs of the European Development and Investment Funds 2014 – 2020 (SIE Funds) to support local development projects. Moreover, the National Recovery and Resilience Plan (Piano Nazionale di Ripresa e Resilienza – PNRR) has foreseen 825 million Euros for services, social infrastructures and rural pharmacies to allocate in municipalities with less than 3000 inhabitants and a more specific investment of 300 million Euros for the improvement of the roads[55]. An additional 310 million Euros for the three-year period 2021-2023 have widened the funds[56]. **Figure 26.1** shows the map of the 72 Italian inner "project areas".

[53] https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/
[54] https://www.istat.it/it/archivio/273176
[55] Relazione annuale sulla Strategia Nazionale per le aree interne, Presidenza del Consiglio dei Ministri, Dipartimento per le politiche di coesione, anno 2020, https://www.agenziacoesione.gov.it/wp-content/uploads/2021/11/Relazione-CIPESS-2020_finale.pdf
[56] Ibid.

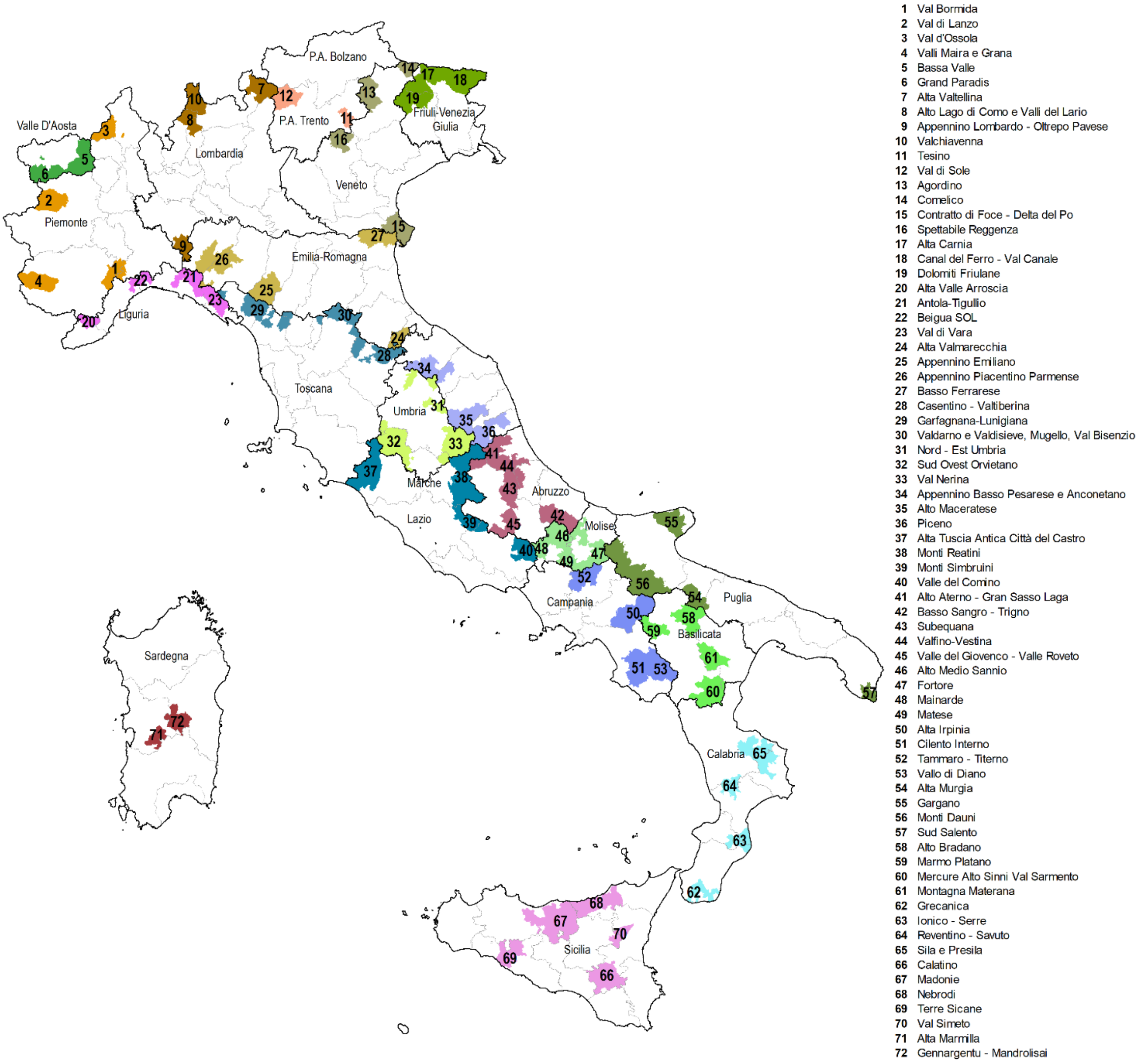

Fig. 26.1 The map of the 72 “project areas”. Source: https://politichecoesione.governo.it/it/strategie-tematiche-e-territoriali/strategie-territoriali/strategia-nazionale-aree-interne-snai/le-aree-interne-2014-2020/

In addition to these 72 areas, in 2022 the Government decided to include also small islands, because they are considered as having the same problems of inner areas in terms of services and distances. They have been grouped in a 73rd area and include about 240 000 inhabitants, divided into 35 island municipalities[57].

Among the inner areas of Italy, it is interesting to focus on specific territories and issues that seem to be representative of the real level of implementation of what is stated in the official documents.

This chapter focuses on the participation processes in the area of inner Cilento ("Cilento interno"), providing two examples of participation, one that can be considered bottom-up and the other top-down, using two tools provided by literature to evaluate whether they are complete or improvable.

The two events are: 1) the MAI-Lab (Laboratorio del Meeting Aree Interne – Inner Areas Meeting Laboratory), performed in Valle dell'Angelo the 1st of July 2023. The laboratory has been built to create a discussion session among young people, other residents, associations, and multiple subjects of the inner areas of Cilento, and has taken place during the MAI (Meeting Aree interne – Inner Areas Meeting) initiative. The host of the event is an agri-food small facility named Àusono; 2): the institutional event organized by the municipality of Roccadaspide about agrivoltaic projects and the dissemination of information about calls for EU funds, that has taken place on the 23rd of September 2023 in Roccadaspide, organized by the coordination office and the areal desk of the Municipality.

The two participation examples are not meant to be representative of every initiative taking place in the territory of inner Cilento, but to build two specific cases which may represent a frame of reference of what can be treasured and/or criticized about participation-related experiences.

The chapter also aims at analysing the statements included in political documents and comparing them with the reality that has been investigated by means of several visits, interviews and questionnaires performed during a period spent on the field, within the framework of a P.O.N PhD project.[58]

It is important to specify that, due to the narrative and informational nature of this chapter, data will be presented in the form of a storytelling, with the aim of disseminating information and giving a point of view which can be helpful for the future decision-making processes.

Regarding the investigation on the field, visits, participation in the events and interviews have been performed to collect data. Then, findings have been discussed trying to use the two tools literature, used to criticize the current practices. In addition to this, the previously mentioned "National Strategy Plan" has been considered, as well as the document "Carta della Partecipazione Aree Interne" ("Participation Chart for the Inner Areas")[59], in order to have

[57] http://territori.formez.it/content/isole-minori-prima-area-ufficiale-snai-2021-2027

[58] developed by the International PhD Programme/UNESCO Chair "Environment, Resources and Sustainable Development" at the Department of Science and Technology, University of Naples "Parthenope".

[59] Cittadinanzattiva, with the support of Strategia Aree Interne, *Carta della Partecipazione Aree Interne*, 2020, https://www.cittadinanzattiva.it/multimedia/import/files/Carta_della_Partecipazione_Aree_Interne.pdf

a set of national specific documents to compare with the local situation. Finally, another evaluation consists in analysing the programmatic document "Strategia d'Area per il Cilento Interno" ("Inner Cilento Areal Strategy")[60] and trying to compare it with the national documents and – more importantly – with the real initiatives on the territory. Inner Cilento includes 29 municipalities listed in the footnote[61], 14 of which are considered as peripheral and ultraperipheral [62]. **Figure 26.2** shows the map of inner Cilento, dividing it according to the territorial definitions that have been described above. Translating the caption from Italian, the first four colours stand for: Belt (orange), Intermediate (light green), Peripheral (emerald green), Ultraperipheral (dark green).

[60] Strategia d'area del Cilento Interno, 2019, https://www.agenziacoesione.gov.it/wp-content/uploads/2020/07/Strategia_Area_Cilento_interno.pdf

[61] Aquara, Bellosguardo, Campora, Cannalonga, Castelcivita, Castelnuovo Cilento, Castel San Lorenzo, Ceraso, Controne, Corleto Monforte, Felitto, Gioi, Laurino, Magliano Vetere, Moio della Civitella, Monteforte Cilento, Novi Velia, Orria, Ottati, Perito, Piaggine, Roccadaspide, Roscigno, Sacco, Salento, Sant'Angelo a Fasanella, Stio, Valle dell'Angelo and Vallo della Lucania.

[62] Ibid.

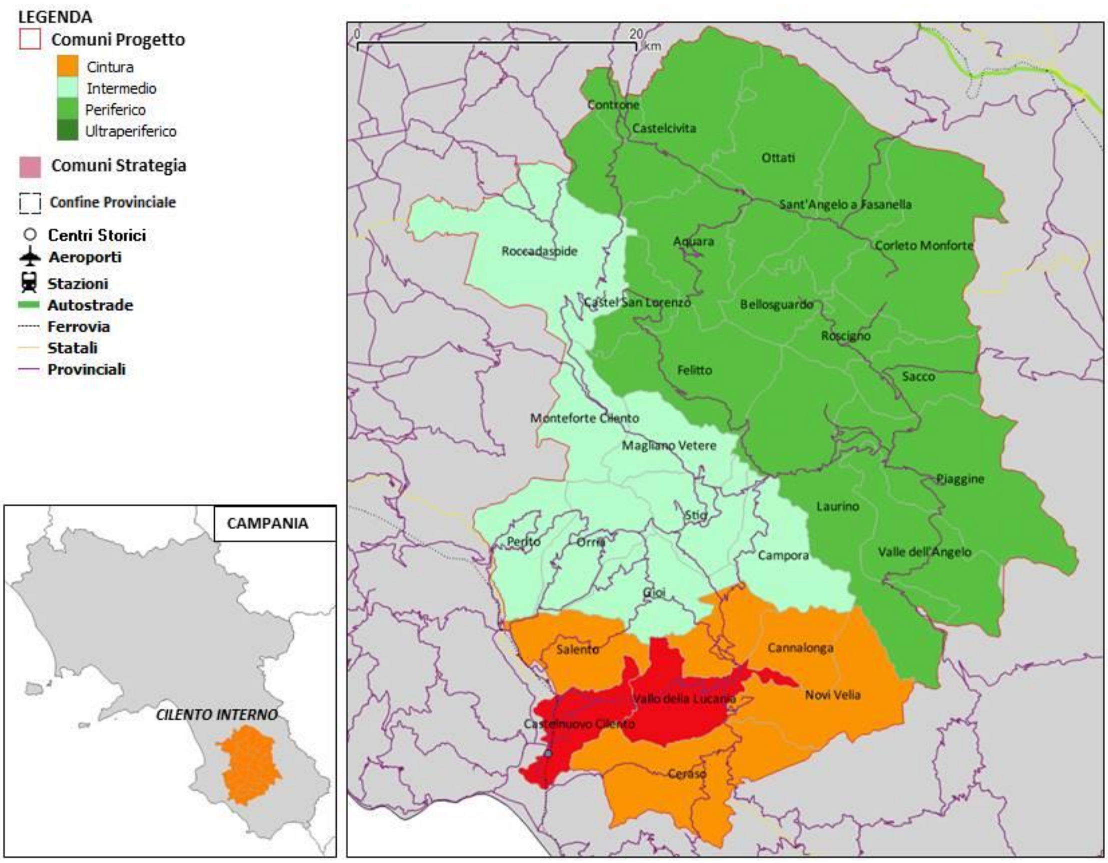

Fig. 26.2 The map of inner Cilento. Source: https://www.agenziacoesione.gov.it/strategia-nazionale-aree-interne/regione-campania-aree-interne/cilento-interno/

Data from the event have been directly collected taking part to the initiative and by means of an interview to one of the organizers.

26.2.1 Two main tools for a critical perspective

Starting from the end of the '60s, it is possible to find several studies and theories about the interaction between local communities and institutions. Without any doubt, the most famous work on the topic is the one published by Sherry Arnstein in 1969, creating a linear progressive diagram (the "ladder") of the levels of participation, starting from the absence of citizens' control (namely "manipulation") and culminating in the total control by citizens.[63].
As it is possible to see from **Figure 26.3**, the linearity of the model suggests that it has been conceived in an historical and cultural context that did not take into account the multitude of plans that real situations show. The model just goes from level one to level eight, considering that the best circumstance for citizens is the top of the ladder. However, this model has capital importance as it introduced the idea that participation is always a matter of power and that sometimes institutions use the narration of participation to hide the reality of policies that are not participative at all.
Arnstein's reflections were very much concentrated on the exclusion of subjects that she called the "have-nots" and the author is completely aware of some of the limitations of her model. Indeed, in her words:
"The justification for using such simplistic abstractions is that in most cases the have-nots really do perceive the powerful as a monolithic 'system,' and powerholders actually do view the have-nots as a sea of 'those people,' with little comprehension of the class and caste differences among them[64].
Another about Arnstein's ladder is that participation is conceived as a tool of interaction and sharing between the two categories of institutions and citizens: there is no room for the categories of non-citizen inhabitants. Of course, this can be normal, considering the historical period of Arnstein's reflection. In the present world, maybe one of the most representative groups of "have-nots" would be the one of non-citizen inhabitants, being the citizenship rights one of the strongest tools for the exclusion of the poor minorities.
Despite these issues, the ladder is still used as an inspiration for more recent studies on participation, like for example Frelih-Larsen et al (2023), that uses it to create an assessment method for the level of participation in consultations and deliberative democracy about the use of pesticides in EU[65]. Another example is Teladia & van

[63] Arnstein S.R. (1969), A ladder of Citizen Participation, in Journal of the American Institute of Planners, vol. 35, No. 4, July 1969, pp. 216-224.
[64] Ibid.
[65] Frelih-Larsen A, Chivers C-A, Herb I, Mills J, Reed M. The role of public consultations in decision-making on future agricultural pesticide use: insights from European Union's farm to fork strategy public consultation. J Environ Planning Policy Manage. 2023; 25: 476–92. https://doi.org/10.1080/1523908X.2023.2212369.

der Windt (2022): the study includes Arnstein's model within a new framework based on the Socio-Ecological System Framework and assess the level of participation in Dutch energy communities [66].

Arnstein's ladder – although its declared limitations – seems to be appropriate for the evaluation of one of our cases of interest, which is the institutional event organized by the municipality of Roccadaspide about agrivoltaic projects and the dissemination of information about calls for EU funds. The results of this evaluation are presented in next section.

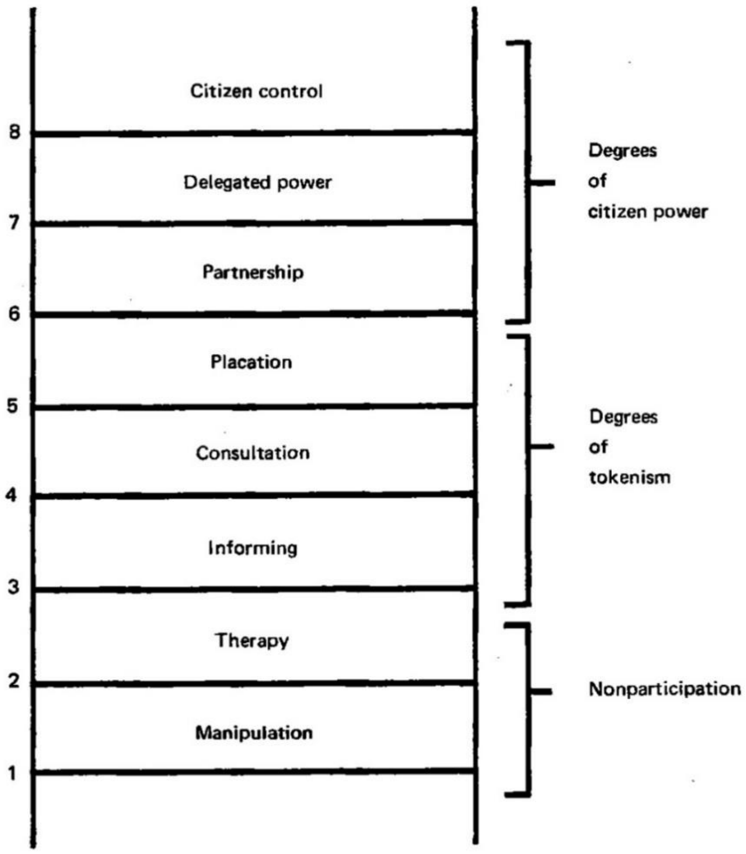

Figure 26.3 The Arnstein's model of the Ladder of Citizen Participation Source: https://organizingengagement.org/models/ladder-of-citizen-participation/

[66] Teladia, A., van der Windt, H., A new framework for analysing local participation in community energy initiatives
IOP Conf Ser Earth Environ Sci, 1085 (2022), Article 012034, 10.1088/1755-1315/1085/1/012034

The boundaries of participation have been widely explored also by Luigi Pellizzoni in his "Participation Circle"[67]. The "circle" creates a distinction between private and public participation, but also between civil and political participation. It is interesting to notice that, in this model, the common identification of the private dimension with the civil one, as well as the assimilation of public and political issues is dismantled, so that the four dimensions can be matched together in four different combinations.

To make the model simpler, Pellizzoni creates four paradigmatic situations that represent each quadrant, using football as an exemplary topic.

We have reproduced here the circle without the example of football, using examples that fit better in the overall contest of one of our two cases of interest, the MAI event. **Figure 26.4** represents the "Participation Circle" adapted to our work:

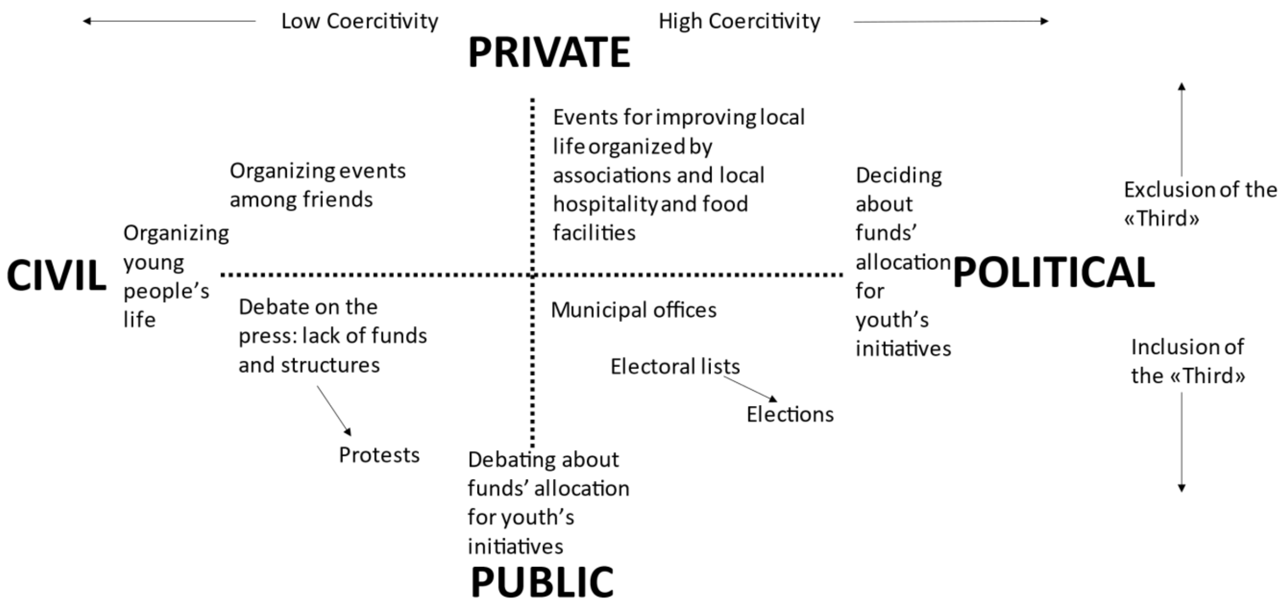

Figure 26.4 The circle of Participation by Pellizzoni adapted to our work

67 Pellizzoni L., 2005, «Cosa significa partecipare», Rassegna italiana di sociologia, 46, 3, pp. 479-514, DOI: https://dx.doi.org/10.1423/20432

As it is possible to see in the figure above, Pellizzoni's idea is to state that the civil and the private dimensions do not coincide and that there is the possibility for a civil/public dimension, as well as for a political/private one, depending on the inclusion/exclusion of the "third": this is the reason of the presence of the two vertical spheres of "Inclusion of the Third" and "Exclusion of the Third". The notion of the "third" can be controversial, since its identity is not precisely defined: sometimes it consists of a material subject, sometimes it is represented by the ideal asset of a relation among the individuals of a community. The fundamental property that the "third" must have is to represent the principle of accountability. The idea of the "third" – as a turning point for the distinction between the public and the private – derives from the Lockean and Hegelian distinction between the private/familiar domain and the public one, the first being characterized by the absence of the "impartial judge" (the "third") and the second by its presence. But Pellizzoni's scheme also includes the Marxian and Gramscian idea that the element of power is the one determining the difference between the private and the public field[68]: this is the reason why the scheme includes the two horizontal spheres "High Coercitivity" and "Low Coercitivity".
In Pellizzoni's diagram, elements from our second case of interest have been put into it instead of the examples that he created for his publication.

26.3 Findingds and Discussion

Being the topic of this chapter politically and socially shaped, findings and discussion have been joined in one section, in order to give critical observations together with the outcomes of the research. The first event that has been analysed (following the chronological order) is the MAI (Meeting Aree Interne – Inner Areas Meeting).
The organizers are some local associations: the association "Vojto", which has also created the festival "VDA Music Potlach" in Valle dell'Angelo; the association Rehub Alburni APS, which is involved in the creation of cultural networks in inner Cilento; the association "Sfavilla" from Villa Littorio; the association "Raccontare Significa Resistere" from Castel San Lorenzo; the association "Dynamicor" from Corleto Monforte; the association "Spazi Attivi" from Trentinara. These associations invited young inhabitants of inner Cilento to participate in the MAI lab and in the MAI event, starting from an initiative of two among them, "Rehub Alburni" and "Vojto": creating a traveling event which could promote both associations and companies managed by local young people. This intention met

[68] Ibid., p. 11.

the interest of the working group “Presidi Culturali nel Cilento Interno” (“Cultural Hubs in Inner Cilento”), whose intent was to perform research on young generations of inner Cilento.

The event has been analysed as an example of self-organization of local communities about some relevant issues, which can be grouped into the macro-themes of services, environment, economy and culture/social change. The grouping into these macro-themes has been possible only after our participation in the event: indeed, at the beginning, the arguments proposed by the organizers were: “residing, distance, desire, belonging, perspectives, relationships, prejudices and habits”. Then, analysing the questions and the answers that emerged, it is possible to say that the proposed arguments were articulated following the main macro-themes that the research group have listed above.

Figure 26.5 is a picture of a panel that has been built during the laboratory, using all the thoughts and proposals that came out in the course of the discussion. The panel was installed also during the evening event, to present a creative summary of the proposals that had been collected in the afternoon by the participants in the MAI-Lab.

As it is possible to see, the main questions are written in block letters on the blue carton board, while all the little answers are put on them by means of little yellow post-it notes.

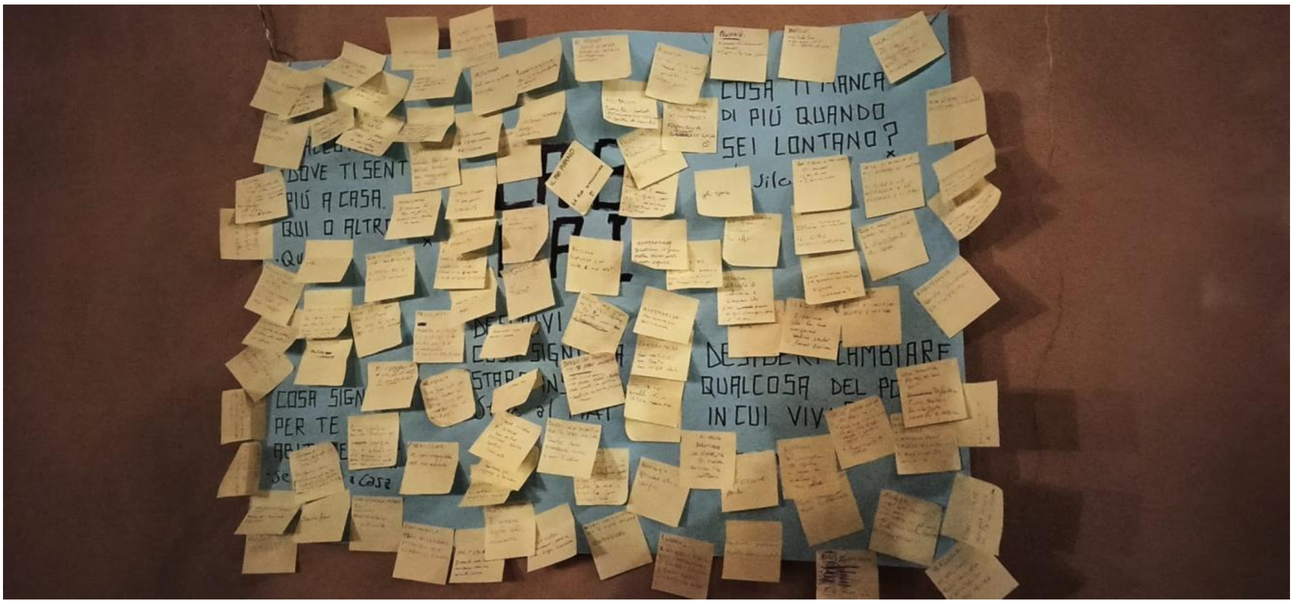

Figure 26.5 The MAI-Lab Panel

The aim of the event has been to formulate proposals and provide realistic data for the policymakers to engage good practices and promote the territory. This is why the ideas on the yellow post-it notes are both about big issues and simple family memories: the attempt was to give value to the problems that young people experience in the inner areas, but also to the cultural heritage that they are still connected to.

Figure 26.6 shows the detail of a single post-it note representing a big problem of the territory: the isolation and the lack of connections among the provincial roads, but also the need for a better cleanup and maintenance of the footpaths on the mountains and country places. Indeed, the note (in Italian) says: “Isolation. Solving the problems of the provincial roads, cleaning up the footpaths and keeping the municipal roads open”.

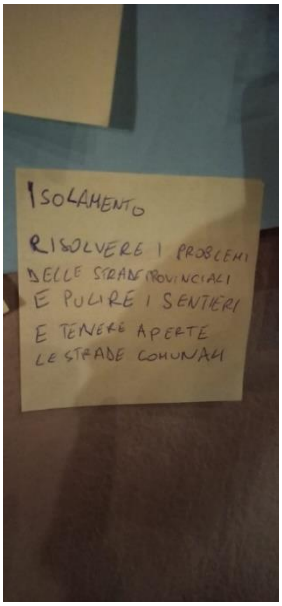

Figure 26.6 Detail of a single post-it note on the MAI-Lab Panel

On the other hand, **Figure 26.7** shows a very “personal” idea put on another post-it note, which confirms the double intention of the laboratory and represents the local cultural values. The note says: “I miss eating mum’s *ciambotta* when I’m away” (*ciambotta* is a local traditional dish prepared with vegetables and olive oil).

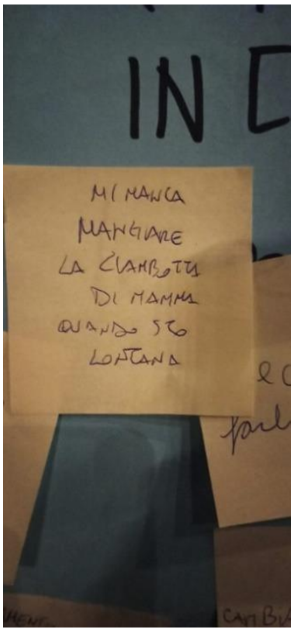

Figure 26.7 Another detail representing a post-it note about family cultural heritage and local food

The methodology that the laboratory has tried to perform is the Action-Research and the approach is declared to be bottom-up. Action-Research is a methodology whose main assumption is the idea that the researcher can understand only the facts that she/he participates to change. This is very different from (but sometimes confused with) the fact that many researchers – especially those belonging to the technical disciplines – also work on the territory, for example in consultancy performances. Action-Research is made of a bi-univocal relationship between the researcher and the territory, which is not the case of consultancy works. Moreover, Action-Research is not even identifiable with participated city/town/regional planning, which consists in a "democratization" process of decision making and in the direct involvement of inhabitants about the planning and projecting of the territories where they live. Action-Research, in conclusion, is a research methodology, which should not be confused with professional practice approaches[69]. Since the organizers of the event have both taken part in the laboratory and collected data for a research study and a document to be created and addressed to local institutions, Action-Research requirements seem to be respected for what concerns their presence in the process.

[69] Saija, L., 2016, La ricerca-azione in pianificazione territoriale e urbanistica, Publisher: Franco Angeli/Metodi del Territorio.

Following the scheme of Pellizzoni's "Participation Circle", we may conclude that the MAI initiative might be interested in becoming a civil/political organization whose final intention aims at performing a public/political action on the territory but is still positioned into the private/political quadrant. This result is evident for two main reasons: 1) ontological: the promoters are not a movement or a political party but a group of local associations and single individuals, together with small local businesses; 2) intentional: the promoters of the initiative are interested in the decisions about the allocations of funds for youth's policies but they have created an event that has been hosted by a private subject (the agri-food small company), without the creation of an electoral list or program.

Of course, in the next future this situation is likely to be changed, since the goal of the research performed by the organizers is to create a document to be addressed to the local institutions. This means that, as well as in the Pellizzoni's original diagram, there is the possibility to pass from a quadrant to another, thus forming a real "circle". On the other hand, the interview to one of the organizers also outlines the intention to create a branding for MAI in the future: this may divert attention from the public goals and attract energies towards market/profit-oriented horizons, so the challenge is now to understand whether the working group will undertake a collectivistic or an individualistic path.

The other case of interest analysed here is the initiative about agrivoltaic EU funds that has taken place on the 23rd of September 2023 in Roccadaspide, organized by the coordination office and the areal desk of the Municipality.

Agrivoltaic projects are realized planting photovoltaic panels in agricultural fields. The important thing to understand is that, from the moment of the installation, the process of agricultural production needs to be changed, according to the presence of these sun-shading panels. For this reason, in is very important that farmers are completely aware of all the consequences of the adoption of these measures.

Using the participation ladder by Arnstein, we may say that the initiative represents a level 3: Information. Indeed, some experts and responsible from the territorial institutions (local and regional) have been invited to give explanations about agrivoltaic projects and some related calls for funding local initiatives. **Figure 26.8** shows the ratio behind the organization of the event and its results, according to the elements that the research group have collected.

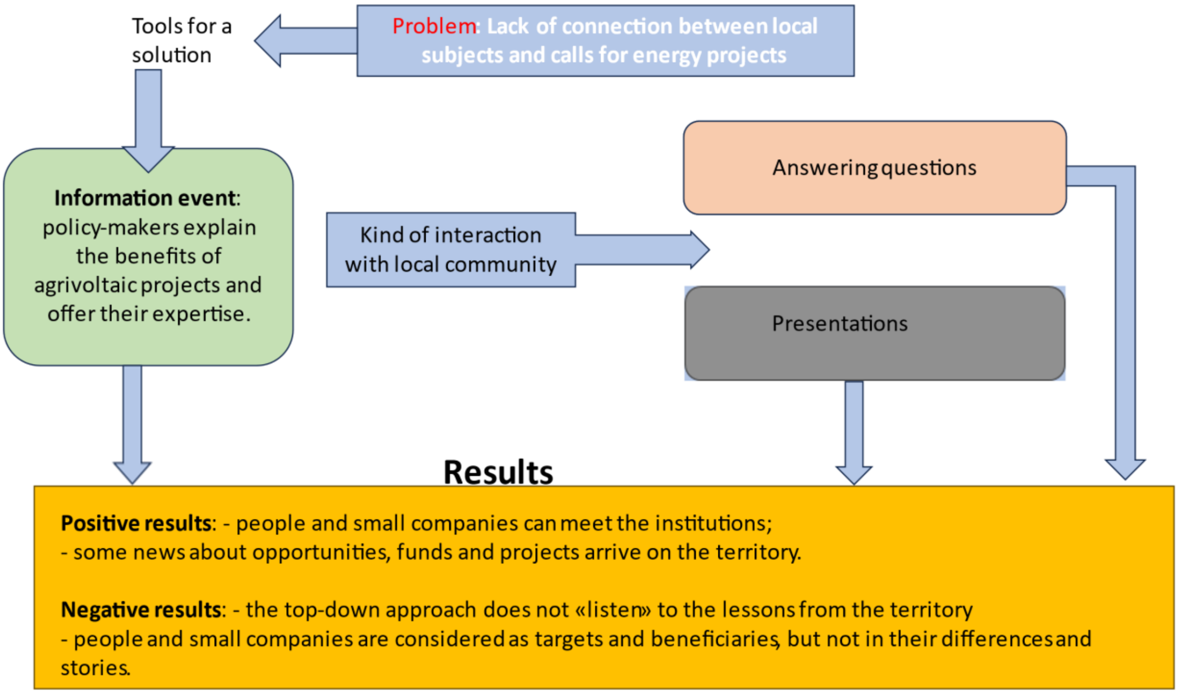

Figure 26.8 Ratio and results of the event about agrivoltaic in Roccadaspide

An important element to be considered is that the deadline for the funding opportunities was very close to the date of the informative event.

Reading the above mentioned “Inner Areas Participation Chart”, it is possible to find principles like the one that states that citizens’ participation should include all the phases of public policies, starting from the agenda and then going towards the decision, the programming and the implementation. Following this principle, an event that only provides information about funding opportunities in a moment that was very close to the deadline cannot be considered very much participative at all.

Taking part in the event, some interesting questions and critical speeches from the audience proved that the real needs of the territory are peculiar, that EU projects are often conceived in places that are far from the implementation areas and that people from the territories should be listened more.

It is evident that the level of mere information is not enough, because the local actors are informed about opportunities that are not feasible on that specific territory.

However, it must be said that the areal desk was born only in April 2023 and that its operators, when interviewed, have expressed the interest to widen the range of initiatives to incentivize participation.
Discussing the specificity of the areal desk, it is possible to say that it is managed by a new generation of social facilitators and that they are trying to change trends of participation policies in the territory of inner Cilento. From the interviews, it is evident that they are also trying to involve universities and different actors to create a transformative approach for participation policies. Of course, they will need time to invert the course of policies that did not work in this direction and this can be the reason why the initiative of Roccadaspide was interesting but still followed some old pattern.
Leaving the initiatives to highlight only two last problems detected in the documents, it is possible to focus on the distance between what is declared in the strategic documents and what is really implemented on the field, and the fact that sometimes documents promote the market as a solution. If we read the “Inner Cilento Areal Strategy” mentioned above, we can see that a wide amount of problems are detected about the local health system, the transports and education, but solutions seem to be proposed only creating job opportunities and a market on natural resources and the agri-food dimension. There is even the use of the expression “product/territory” to promote the development of inner areas in a modern declination.
This perspective can create some economic benefits, but it is important to take into account that environmental and social impacts of such an identification of the territory with a product can be significantly negative.
A vision about what is a just way to create job opportunities and well-being should include evaluations on several dimensions that cannot be compressed in the economic one.
Also staying in a merely economic field, it is possible to say that inner territories and the participation processes of local communities can be a pillar in a just transition towards circular economy, because of all the cultural heritage of preservation, reuse, recycle, regeneration, care and life cycle extension that these territories can express. If participation represents only a good word for documents and public speeches, while decisions are taken elsewhere, all this heritage will not even be seen.

26.4 Conclusions

The experience of the MAI teaches that, although the rhetorical elements of participation can be present in many initiatives, their destiny depends on the collectivistic or individualistic purposes that groups from below can chase. More specifically, not all the initiatives that can be defined “from below” are necessarily aimed at achieving collective dimensions or advocacy of political relevance. “From below” we find activists, associations, NGOs, small companies, young entrepreneurs, etc… So, it is important to go beyond the rhetorical aspects about participation in each initiative to understand whether participation is a concrete good practice or just a “spot”.

This is true also for what concerns the “top down” initiatives: as the initiative of Roccadaspide can show, there is still need for a real inclusion of the instances and claims of the territories, before organizing such meetings, otherwise the risk is that they only represent occasional fake events, created to show to the higher institutions that the local ones are working on the territories.

But the critical perspective is necessary to evaluate the intentions and the actions of all the actors, so we should also focus on the lack of interest about the territorial specificities that sometimes characterizes the higher and centrale institutions, for example EU.

To overcome the problem described above about funds that are available for projects that do not comply with the needs and heritages of some territories, much more needs to be done in the sense of research, consultations, cognitive investigations, etc…

Good policies should take into consideration both the top-down and the bottom-up dimensions to create a more participated life for territories in inner areas and everywhere, but the suggestion that applies to the two dimensions is to overcome the surface and go towards a real knowledge of the local needs. Bottom-up initiatives, as well as top-down ones, may exclude some subjects if the goals are shaped by market-oriented groups or, on the other hand, if solutions are developed by institutions that do not have any knowledge about the local problems.

This can be fundamental in terms of who participates: for example, some municipalities of inner Cilento like Sacco are hosting migrant communities that are not even taken into account in these initiatives, being citizens the main protagonists/target of both the bottom up and the top-down cases.

Hopefully, the current interest for inner areas will create new opportunities to decline projects on the real needs and vocations of such territories.

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CONCLUSIONS

This eBook aims to provide scholars, practitioners and policymakers with an overview and a rigorous and exhaustive analysis of the complexity and criticality of the current state-of-the-art knowledge in the field of CE. These aspects have been analysed in the various chapters (using a variety of methodological, theoretical and empirical methods in different socio-economic contexts). The book provides a broad picture of the problems, criticalities and barriers characterising the current transition towards a just CE. In line with the spirit of this e-book and the project behind it, the contributions of the chapters have directly and indirectly brought out a certain number of indications for transformative policies capable of changing the assumptions underlying the current linear economy model and directing attention towards more comprehensive CE models, based on stakeholder engagement and socially awareness both in terms of research and practice. The salient points of these transformative policies and research implications are summarised below.

Transformative policies

The mainstream neoliberal CE model cannot jointly address social and environmental perspectives and goals. A new socio-economic phase is emerging that calls for models that are more aware of social needs and environmental justice implications. This emerging phase should lead towards Transformative Policies capable of generating more comprehensive and socially inclusive CE models in research and practice.

Integrating diverse groups, cultures, and areas is critical in a globalised world. A transformative CE model must focus on GN and GS relations aiming to highlight (and change) the impacts of GN decisions on GS (both at production and consumption level). It is vital for the GN, as well as for the affluent classes in the GS, to transform their materialist and consumerist lifestyle, as it is at the heart of present injustices and socio-ecological impacts.

A transformative model of society must focus on stakeholder engagement so that citizens are not just consumers but actively contribute to the CE transition, for example, as producers, users, and repairers. The EU should make changes to its CE policies to prevent widening the gap between different areas and increasing social and environmental injustices. A TP should feed these changes towards a more just transition by integrating, on the one hand, the specificities of different geopolitical contexts and, on the other, environmental and social justice with the CE. In particular:

a. TPs must consider geopolitical differences within the EU and meet long- and short-term needs. In the GN, policies are business-oriented, and citizens have little or no power. In many GS countries, policies are more flexible but limited by the rules of large companies from the GN. TPs should focus on decolonising circularity, that is, considering the plurality of forms of understanding and implementing CE and disrupting geopolitical power relations;
b. TPs should focus on integrating environmental and social justice issues into CE policies, in order to avoid perpetuating the same environmental and social injustices created by the current linear economic model. Just as an example, gender considerations in the CE perspective should go beyond the SDG approach and lead towards reframing valuation systems so that they can properly incorporat social and reproductive work, which is crucial for socio-ecological sustainability. Gender justice must thus play a key role in both CE research and policy. TPs should focus on the causes of labour inequalities that are being reproduced by the application of CE. More research and analysis are needed to generate and disseminate the appropriate knowledge on the causes of these problems and the cultural/interpretative approaches to be adopted.

Socio-ecological systems should be guided by concepts of common good, public happiness, and quality of life. These principles must be stated as unavoidable requisites for a TP aimed at creating a virtuous circle with institutions, policymakers, citizens and companies. Non-quantitative indicators are needed to map the complexity and the different ways this vision of social and ecological well-being is advanced. Any transformative policy seeking to create desirable sustainable futures must consider the need to grasp and *protect* the variety of relations between human and more-than-human life. To meet this crucial task, any socially desirable CE should conform to the concept and practices of Responsible Research and Innovation (RRI). The latter puts people and the planet at the centre of the debate and helps design transformative policies aiming to achieve both social and ecological well-being.

As a consequence of such a well-being vision (common good, public happiness, life quality), new metrics and new indicators capable of capturing the different dimensions of sustainability constitute an indispensable element for the transition towards a more socially aware CE. The transition to a more sustainable socio-ecological system and CE cannot be pursued in the context of the current growth-based capitalist economies. TPs towards a just transition to socially aware CEs must take into account social variables and related drivers and influencing factors. TPs must consider different geopolitical aspects and socio-ecological models (production and consumption) in the GS and the GN to respect local specificities without imposing production and consumption models that generate economic, social, labour and environmental injustices.

It is well known that Africa is a very differentiated reality from multiple points of view (economic, social, natural, cultural, political). A CE policy for the entire continent is still missing, and CE is not yet part of Agenda 2063; nevertheless, country-specific actions have been adopted. A transformative CE policy for all of Africa should be adopted, which considers country differences and similarities. This is key to react to the power of countries and companies of the GN. In contrast, the EU has one of the best CE regulatory systems, which is recognised worldwide. However, the results of these systems are not equitably shared among countries, and actions high in the EU waste hierarchy (prevention) are poorly supported. Finally, CE policy approaches adopted by China and India highlight different levels of progress in both countries. China seems to be moving beyond waste management and adopting policies that address social goals and the targets of SDGs (Xie et al., 2021).

The diverse scenarios that emerge in different economic and geographical areas highlight the importance of sharing political actions and involving stakeholders and citizens in influencing the affirmation of different CE perspectives. Transformative innovation policies must take into account territory-specific factors in order to support local communities in their efforts towards a just transition. Stakeholder engagement, cultural diversity, local experiences and community needs are crucial to transform the CE transition into a just transition and improve socio-ecological well-being. As a consequence, policymakers will have to increase their efforts towards appropriate and unified norms at the global level while ensuring flexibility of their application at local levels. In this regard, it is vital to use qualitative and quantitative indicators to measure progress at appropriate spatial and temporal scales, including environmental and gender dimensions and levels of stakeholder engagement.

Policy implications

A deep consideration of the Chapters in this e-book highlights the importance of critically evaluating the CE paradigm to foster a just transition, particularly concerning unaddressed topics such as environmental and social injustices. As a result, it emerges that appropriate TPs may have a key role in supporting a transition to CE and reducing the current environmental and social injustices, including those based on gender. Most case studies in the literature still provide a reductive vision of the CE, excessively focused on waste management and recycling. Waste recycling is a secondary solution compared to reusing, repairing, and preventing waste production by design, aiming to extend product life and reduce resource consumption. CE is a much wider concept that involves the entire socio-ecological system of a country, from production to consumption. Furthermore, CE is considered by some an umbrella concept (Murray et al., 2017) since it originates from different schools of thought that break with the neoclassical theory and envision socio-ecological change with varying levels of radicality. Chapter 1 points out the importance of environmental services provided for free by Nature. As suggested by Pearce and

Turner (1989) and by Odum H.T. and Odum E.P. (2000), disregarding the contribution of environmental services would only end up strengthening the linearity of the economic system. Consequently, chapter 1 has briefly outlined some emerging conceptual solutions for a more socially aware CE, such as the “social & solidarity economy”, the “care-centred economy”, and the “civil economy” paradigms. These are important models to monitor for policy purposes since they appear to overcome the limits of the mainstream CE, which is still based on the neoclassical paradigm where economic decisions are mainly driven by prices and profit and consumption maximization goals and neglect the social impacts and injustices generated in the society.

It should be highlighted that the current focus on mainstream CE gives rise to serious problems, in clear contrast with the just transition approach. For instance, the trade and flow of waste from the North to the South, and the poor working conditions in which waste collection and recycling activities are carried out in the GS (e.g. case studies of waste pickers in Bangkok, in Brazil, in Ghana for example; nevertheless, in the GN the case of Barcelona and Catalonia showed that about 5000 informal waste collectors worked in that region, shedding light that the phenomenon is also present in the EU).

This highlights that implementing a CE, particularly in the sectors of waste management that are regulated and oriented towards the objective of economic efficiency and recycling (e.g. WEEE, municipal solid waste), addresses only some of the environmental and social impacts or externalities of waste management. Therefore, to ensure a just transition to CE, an in-depth analysis of the impacts on the most vulnerable people in the GS.

The studies in the book also show that a transition to CE in the GN has negative effects in other geographical areas, particularly in the GS. More precisely, relevant obstacles to a just transition are the formally regulated waste management and recycling systems and their market-based objectives focused on economic efficiency at the expense of environmental and social objectives. As a result, the consideration of alternative and more participative business models as well as economic paradigms beyond neoliberalism is essential to reform the formal systems of waste management and recycling and their functioning.

Research implications

Focusing on the three parts, the topics of interest towards which scholars could address their future research efforts can be summarised as follows.

Part I: Basics of the CE and state of the art

- CE models that are capable of interpreting and representing greater social awareness.
- Identifying barriers and driving factors towards a Just to CE transition and the related determining factors.
- Considering measures of shared responsibility between different actors/countries in technological transition processes, as highlighted in the case of electric vehicle technology.
- Greater attention to initiatives and strategies for stakeholder involvement in the transition to a just CE to incorporate economic, social and environmental issues.
- Evaluate the specific factors of regional models of EC development for a better plurality of theorisations and interpretations capable of supporting the adoption of appropriate political measures for a just transition towards the EC.
- Comparisons of GN and GS case studies are needed to evaluate possible common patterns and best practices.
- Application of a decolonial approach to facilitate the understanding of the costs and benefits of a CE transition for a wider range of peoples and territories.

Part II: Measuring the Circular Economy

- A further and more in-depth exploration of indicators beyond GDP, especially indicators that meet stakeholder expectations and needs regarding the measurement of performances in the CE transition.
- A further and more in-depth exploration of new hybrid research approaches for indicator development as an alternative to the normative approach to support management strategies and policymaking.
- Assessment of the practical application of CE transition frameworks based on the pillars of responsible research and innovation to better understand their practical value and limitations.
- Evaluation of how the CE contributes to achieving sustainable development goals in the GS context and how the research knowledge collected so far is favouring the improvement of well-being in the GS.
- Further exploration of indicators and existing methods (for environmental, social and economic assessment) to understand their strengths and weaknesses and how they could be integrated to measure and promote a CE transition that increases socio-ecological well-being.

Part III: Towards a Just CE: key concepts, national paths, and scenarios

- Analysis of winners and losers in CE transition and identification of appropriate policy measures to mitigate the stakeholders affected negatively by the transition.

- Identification and analysis of environmental and social benefits and costs of measures to improve the labour conditions and life of waste pickers. In particular, more in-depth exploration is needed to facilitate the integration of informal waste pickers in the formal economy and improve their technical and entrepreneurial skills to improve their income.
- Analysis of the gender dimensions in CE transition through case studies, in particular from the GS, since most of the current empirical cases regard the GN.
- Case studies adopting a gender innovation perspective in the research process to better understand the implication of a CE transition on reproductive care work and on women and other vulnerable people.
- Analysis of qualitative aspects related to labour in CE case studies to understand the point of view of labour about the CE transition and its implications. Studies about workers' decision-making power and agency, gender inequalities and racism in the labour market are also very welcome since such aspects are rarely investigated by the current literature. There is also a lack of studies addressing informal workers' labour conditions in the GN, such as the case study of Barcellona waste pickers workers.
- Analysis of policies and regulations supporting the take-up of CE practices in Africa, including: a) green public procurement, infrastructure and technological development, and financial instruments; b) support to entrepreneurial activities, improvement of data collection and management about resources flows and their recirculation in the economy; c) environmental and social assessment of benefits and costs of the adoption of digital and innovative technologies and automation.
- Given the EU's diversified state of the CE transition, case studies of well-performing areas are required to disseminate best practices and help less-performing regions reach a more equitable CE transition.
- Environmental and social assessments of CE development in China and India are also relevant and much needed, especially considering a just transition lens.
- More research is needed to shed light on citizens' preferences for future circular scenarios and what circular economy and society policies they would choose in a democratic context. This analysis would help policymakers and practitioners envision a more desirable circular transition that could bring about human and planetary well-being.

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List of authors and their affiliations

1. **Álvarez Martínez Bibiana**, Universidade de Santiago de Compostela, Santiago de Compostela, Spain.
2. **Andersson Gavin,** University of Cape Town, Graduate School of Business, Cape Town, South Africa.
3. **Andrè Mateus Bertolino**, Positivo University, Curitiba, Brazil; Federal Institute of Education Science and Technology of Paraná, Brazil.
4. **Arsova Sanja**, The University of Sheffield, Sheffield University Management School, Sheffield, UK; South-East European Research Centre, Thessaloniki, Greece.
5. **Bimpizas-Pinis Meletios**, The University of Sheffield, Sheffield University Management School, Sheffield, UK.
6. **Casazza Marco**, University of Salerno, Department of Medicine, Surgery and Dentistry "Scuola Medica Salernitana", Baronissi, Italy.
7. **Celebi Dilay**, South-East European Research Centre, Thessaloniki, Greece.
8. **Chinyepe Andrew**, Scientific and Industrial Research and Development Centre, Harare, Zimbabwe.
9. **D'Alisa Giacomo**, Autonomous University of Barcelona, Institute of Environmental Science and Technology, Spain; University of Coimbra, Center for Social Studies, Coimbra, Portugal.
10. **Davids Lester M.**, Graduate School of Business, University of Cape Town, Cape Town,
11. **Denes-Santos Danielle**, Positivo University, Curitiba, Brazil.
12. **Desmond Peter,** African Circular Economy Network, Cape Town, South Africa.
13. **Doezema Tess**, Universitat Autònoma de Barcelona, Departament d'Empresa, Catalunya, Spain.
14. **Falcone Pasquale Marcello**, University of Naples Parthenope, Department of Business and Economics, Italy.
15. **Friant Martin Calisto**, Universitat Autònoma de Barcelona, Department d'Empresa, Catalunya, Spain.
16. **Genovese Andrea**, The University of Sheffield, Sheffield University Management School, Sheffield, UK.
17. **Ghisellini Patrizia**, University of Naples Parthenope, Department of Engineering, Naples, Italy.
18. **Gihring Katharina**, African Circular Economy Network, Cape Town, South Africa.
19. **Girei Emanuela**, The University of Sheffield, Sheffield University Management School, Sheffield, UK.
20. **Guillibert Paul**, University of Coimbra, Center for Social Studies, Coimbra, Portugal.
21. **Javad Ramezankhani Mohammad**, University of Kent Business School, Canterbury, UK.

22. **Jimenez Andrea**, The University of Sheffield, Information School, Sheffield, UK.
23. **Kaiser Serena**, International PhD Programme / UNESCO Chair "Environment, Resources and Sustainable Development", Department of Science and Technology, Parthenope University of Naples, Naples, Italy.
24. **Kaltenbrunner Annina,** University of Leeds, Leeds University Business School, Leeds, UK.
25. **Käsner Sally-Anne**, African Circular Economy Network, Cape Town, South Africa.
26. **Kesidou Effie**, University of Leeds, Leeds University Business School, Leeds, UK.
27. **Ketikidis Panayiotis H.**, South-East European Research Centre, Thessaloniki, Greece
28. **Leonardi Emanuele**, University of Bologna, Department of Sociology and Business Law, Bologna, Italy; University of Coimbra, Center for Social Studies, Coimbra, Portugal.
29. **Liu Yanxin**, Capital University of Economics and Business, School of Management and Engineering, Beijing, China.
30. **Llorente-González Leandro J.**, ICEDE, Department of Applied Economics, University of Santiago de Compostela, 15782 Galicia, Spain; Erasmus University Rotterdam, International Institute of Social Studies, 2502 LT 's-Gravenhage, the Netherlands.
31. **Lowe Benjamin**, University of York, School for Business and Society, Heslington, York, UK.
32. **Makhanda Raymond**, Scientific and Industrial Research and Development Centre, Harare, Zimbabwe.
33. **Mandizvidza Cephas**, Scientific and Industrial Research and Development Centre, Harare, Zimbabwe.
34. **Maselli Gabriella**, University of Salerno, Department of Civil Engineering, Salerno, Italy.
35. **Meira Teresa**, University of Coimbra, Centre for Social Studies, Coimbra, Portugal.
36. **Mufunde Tutsirai**, Scientific and Industrial Research and Development Centre, Harare, Zimbabwe.
37. **Nesticò Antonio,** University of Salerno, Department of Civil Engineering, Salerno, Italy.
38. **Pansera Mario**, University of Vigo, Post-growth Innovation Lab, Vigo, Spain; Universitat Autònoma de Barcelona, Departament d'Empresa, Catalunya, Spain.
39. **Passaro Renato**, University of Naples Parthenope, Department of Engineering, Naples, Italy.
40. **Passerella Veronese Marco**, University of L'Aquila, Department of Industrial and Information Engineering and Economics, Italy; University of Leeds, Leeds, Leeds University Business School, UK.
41. **Pinyol Josep Alberich**, ABIS – The Academy of Business in Society, Brussels, Belgium; University of Exeter Business School, Rennes Dr, Exeter EX4 4PU, UK.
42. **Purvis Ben**, University of Sheffield, Sheffield University Management School, Sheffield, UK.
43. **Quinto Ivana**, University of Naples Parthenope, Department of Engineering, Naples, Italy.
44. **Ripa Maddalena**, Universitat Autònoma de Barcelona, Departament d'Empresa, Catalunya, Spain.
45. **Santagata Remo**, University of Naples Parthenope, Department of Engineering, Naples, Italy.
46. **Schenck Catherina**, University of the Western Cape, Cape Town, South Africa.

47. **Sewchurran Kosheek**, Graduate School of Business, University of Cape Town, Cape Town, South Africa.
48. **Sousa Joana**, University of Coimbra, Center for Social Studies, Coimbra, Portugal.
South Africa.
49. **Thomas Antonio**, University of Naples Parthenope, Department of Business and Economics, Naples, Italy.
50. **Timson Sam**, African Circular Economy Network, Cape Town, South Africa.
51. **Torres Fevereiro Jose Bruno Ramos**, The University of Sheffield, Sheffield University Management School, Sheffield, UK.
52. **Ulgiati Sergio**, University of Naples Parthenope, Department of Science and Technology, Naples, Italy; School of Environment, Beijing Normal University, Beijing, China.
53. **Vallès Codina Oriol**, University of Leeds, Leeds University Business School, Leeds, UK.
54. **Van Vossole Jonas**, University of Coimbra, Center for Social Studies, Coimbra, Portugal
55. **Vassillo Chiara,** Institute for Research on Population and Social Policies IRPPS, National Research Council CNR.
56. **Vermeulen Walter V. J.**, Utrecht University, Copernicus Institute of Sustainable Development, Utrecht, Netherlands.

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