Ca' Foscari University of Venice

Master's Degree Programme in
Languages, Economics and Institutions of Asia and North Africa

Final Thesis

The development of Circular Economy in China as a national strategy

Supervisor
Ch. Prof. Daniele Brombal

Assistant supervisor
Ch. Prof. Beatrice Galelli

Graduand
Alda Lila
Matriculation number 848789

Academic Year
2021 - 2022

Abstract

The circular economy (CE) is a trending concept both among policy makers and business actors and is globally recognized as the leading driver towards a knowledge-based economy. Many countries have spent great effort promoting it and China is among the firsts to have engaged in the pursuit of CE on a large scale.

In this contribution we will explicate the evolutionary process of CE in China by (a) investigating the circumstances that prompted its adoption as a national strategy, (b) providing an up-to-date review of China's policy efforts in introducing a legal framework to support its implementation nationwide and (c) elaborating on the underlying barriers and challenges to the full implementation of a CE model.

Firstly, we will contextualize the development of CE by looking into China's era of unfettered industrialisation of the early '90s. This will serve as a link to determine that the Chinese perspective on the CE is broad, and it is built as a response to the environmental and resource management crisis against the background of the international scenario.
Secondly, we will illustrate the current situation of circular economy practice in China to identify the different levels of support and enforcement of this economic system. To do so we will focus on the recent changes in the environmental legislation and related reforms. Particular attention will be given to: the Circular Economy Promotion Law (2008), China's main national-level framework for pursuing the CE; the 11th Five year-plan ; the 12th Five year-plan, in which the circular economy was first upgraded to a national development strategy; and the 13th Five year-plan.
Finally, the paper will identify the underlying barriers and challenges to the full implementation of the concept in China as a national strategy.

Despite the enduring efforts that have been made, to succeed in its mission it is clear that the Chinese government needs to build a more exhaustive system of designing a strategic CE policy, strengthen reliance on its legislative and administrative capacity and set more realistic standards to drive the socioeconomic transformation consistent with the goal of 'ecological civilization' advanced by the 18th Party Congress of CCP (2012).

Table of contents

Introduction

The linear economy has dominated the world's economic development since the Third Industrial Revolution (3IR). A significant transition from the old linear economic model to a circular economic model has only recently become a viable option and an important item of discussion in the global political agenda.

Our economy is now caught in a system that favours a linear production and consumption model which is based on the take-make-dispose method. However, under the pressure of the favorable alignment of economic, technological, and social powerful disruptive trends, "*circularity is making inroads into the linear economy and has moved beyond the proof of concept*" (Ellen MacArthur Foundation, The Circular Economy in Detail).

A circular economy is a model of economic growth that is by definition regenerative, intending to progressively decouple growth and progress from the use of finite resources. Discussion on the topic has flourished after the 2008 financial crisis, which revealed not only serious flaws in financial regulation but also uncovered serious flaws in the credit-based form of growth that preceded it, emphasizing the need for a new economic approach (Hynes et al., 2019).

At the same time, rapid technological change is transforming many areas of our economies. Enabling technologies are nowadays mature and robust enough not only to encourage dialogue on the subject but also to support the application of CE principles across industry sectors (Marieni, 2019).

This transition in the economic paradigm is partly a result of rising public knowledge of environmental issues and global public opinion engagement. Today, more people are willing to embrace lifestyle adjustments in order to address the environmental catastrophe, both as data receivers and producers.

The circular economy is gaining ground among corporate and government leaders alike. The prospect of gradually decoupling economic development has caught their imagination, encouraged innovation, creating more robust employment (The Circular Economy In Detail, s.d.), dampen price volatility, improved the security of supply while at the same time reducing environmental pressures and impacts (Kalmykova et al., 2018). The circular economy would favor individuals as well as enterprises, the environment, and the economy as a whole. Individuals would profit from a structure built on the principles of circularity in a variety of ways, from increased disposable income to better living standards and related health effects (The Circular Economy In Detail, s.d.). To attest to the economic opportunities that a CE model could capture, a 2015 joint study of the Ellen MacArthur Foundation and McKinsey on the development of CE in Europe reports that a CE, "*enabled by the technology revolution, would allow Europe to grow resource productivity by up to 3 percent annually—in so doing, generating a primary-resource benefit of as much as €0.6 trillion per year by 2030 to Europe's economies. In addition, it would generate €1.2 trillion in non-resource and externality benefits, bringing the total annual benefits to around €1.8 trillion compared with today. This would translate into a GDP increase of as much as*

seven percentage points relative to the current development scenario, with an additional positive impact on employment" (McKinsey Sustainability, 2015).

However, the pursuit of system change doesn't have a simple fix. It's difficult to achieve, and failures often come from superficiality in managing the complexities involved. Nonetheless, it's valuable to participate in the debate and continue to question the future scenario in order to survive in a context in constant transformation and with an increasingly high rate of inequality in the distribution of natural resources.

China is no exception to the above-mentioned trends and, given its importance in global production, it is worth analyzing its progress and challenges in bringing about a CE model.

Because of its high growth based on resource-intensive manufacturing, exports, and low-paid labor, China provides an essential introspective on the view of benefits and obstacles behind the development and implementation of the circular economy in a pre-existing system, in this case, that of a Socialist Market Economy (SME - 社会主义市场经济).

Since China reformed its economy in 1978, GDP growth has averaged almost 10 percent a year, and over 850 million individuals have been pulled out of poverty as a result (The World Bank, 2020). However, the last decades of rapid growth, urbanization, and industrialization have been matched with negative environmental impacts. The move to a circular economy, according to experts, offers substantial opportunity to produce new value and economic growth.

Unlike the recent wave of CE efforts that emerged from the private sector in Europe, however, the country's efforts have been broader (McDowall et al. 2017) and, following a top - down approach, led by the national government. China has made significant progress in building CE-related regulatory tools, which include laws on public and private investments, green process innovation, and public awareness. Against this background, this thesis intends to focus on the analysis of China's regulatory and policy efforts and their results.

There has been an expanding corpus of literature examining the CE in recent years. Four reasons (environmental problem, resource scarcity, international comparativeness, and national security) illustrate the imperative for China to adopt a more sustainable way of development. Given the importance, our research provides a review of studies in this field intending to give a panorama of CE development and impacts in China.

The past practice and recent evidence have suggested that improvements in CE will come in waves, and that these waves will spread across the country in a variety of ways, thanks to significant projects: from sectors of the economy that have great environmental externalities to those which are less environmentally damaging and from regions with the effective government to those with less effective government, from cities with agglomerated industrial districts, or EIPs, to cities with sporadic industrial businesses. Existing policies encompass the fields of production, consumption, and waste management and are conducted simultaneously at the micro, meso, and macro levels.

Other governmental and non-governmental groups provide assistance in promoting, advertising, regulating, and monitoring the circular economy's implementation.

In our review, we find that indicator evaluating systems are the most widely used instruments for the assessment of the development of CE, disregarding the economic scale level. At the corporate level, indicators are adapted to the features of specific enterprises or industries. At the EIP level, two governmental organizations NDRC and SEPA have issued two different indicator evaluation systems. The former focuses solely on the implementation of the 3R principles, whereas the latter also evaluates the influence of EIP on economic, environmental, and social factors. The indicator systems are often based on CE's ultimate aims and 3R principles at the regional level, where scholars' studies are the most prevalent (Wang et al., 2007), but few scholars built the indicator system based on ecological efficiency theory (Zhou et al., 2006). Nevertheless, due to the lack of defined, standardized quantifiable objectives, assessing China's status in the circular economy adoption process as a whole has been challenging.

A lack of trustworthy information, modern technology, inadequate legislative enforcement, insufficient economic incentives, poor leadership and administration, and a lack of public awareness are among the other obstacles to the circular economy's successful implementation in China.

Bearing those problems in mind, the 12th five-year plan (2011-2015) has advanced the adoption of CE in China to a deeper and broader level. It is evident that a transformation into a more sustainable way of development is now very high on the policy agenda of China's government, and the measures that it has taken show that a significant amount of work is being put into realizing CE's lofty and admirable goals. Given the economy's complexity, heterogeneity, and substantial regional disparities, the issue as to whether this improving trend can be continued or if the country returns to previous habits and norms still remains.

But one thing is certain: if China wishes to make steady growth and achieve CE on a national scale, immense efforts are required to perfect existing measures as well as to deploy a wider range of policies to break down the challenges that the country has to face.

The thesis has the following structure:

Firstly, it defines CE and gives a context to its development.

Secondly, it describes the development of CE in China and the reasons that prompted the government to adopt it as a national strategy.

Then, it will introduce Chinese CE objectives and map the policies that have been adopted to pursue the goals of the government. The CE approach's ultimate goal is to decouple economic growth from the depletion of natural resources and environmental damage and construct a society that is resource-efficient and environmentally conscious. The CE has been promoted by the Chinese government on several fronts, including legislation, policy reform, pilot projects, and monitoring and evaluation initiatives. Several legislations have been passed in recent years to aid

the transition to a circular economy. The majority of these are industry-specific. Therefore, we will focus on the main regulatory instruments that contribute to the Chinese government's overarching goal of implementing the circular economy.

Finally, it will elaborate on underlying barriers and challenges to the full implementation of the model. Progress made and challenges ahead for the attainment of a CE model will be discussed in this section, vis-à-vis the goal envisioned by government policies.

Sources employed to draft this thesis include both scientific literature, grey literature (government, NGO, and industry reports, statements released by CE practitioners), and original regulatory sources (laws, standards, etc.).

序言

世界受到气候变化、人口增长和资源有限的压力,随着第三次工业革命,线性经济在世界经济中占主导地位,到过去的一年,从传统线性方法到循环经济模式的全面转变成为现实的替代方案,成为全球政治计划的重要项目。

为了满足人类日益增长的需求,现代经济体系始终支持资源发展和环境转型,作为环境的受害者,揭示了社会发展与环境保护之间的平面。

为了应对气候变化和其他环境挑战,并为下一代寻求福利,该国正在寻找最著名的循环经济发展的替代模式。

尽管转向循环经济有许多障碍,但它也为全世界带来了许多机会和潜在的好处。

循环经济是一种可以通过加速、关闭和缩短材料和能量周期来减少成本、浪费和资源排放的系统。循环经济预测未来, 所有生产的产品都精心设计和使用多个周期, 各种材料和生产周期精心匹配。循环经济旨在通过有效的过程, 预防, 重复使用, 修复, 加工和回收废物来减少资源的消耗。

作为一个新的经济发展模式,循环经济成为我们这个世界的新模式,以缓解资源短缺和解决环境污染,同时保持经济和社会可持续性,开发有效的方法。

本文分析了中国进化的原因和过程,基于当前政策的制定,基于中国政策的特点,重点是政策,政策规模,政策手段等。并提供对中国发展趋势的了解。

在 1978 年改革和开拓之后,随着工业化的快速进展,中国的发展继续稳定前进,这种强大的发动机背后是天然资源的消耗和基于煤炭的燃烧。

中国的能源消耗和二氧化碳排放在世界顶峰,污染问题越来越严重,资源短缺需要紧急解决,中国领导人意识到,改善环境质量只能采取更有意义的措施,他们认为中国应该努力加快经济增长的变化,强烈发展循环经济,建设物质文明,政治文明,精神文明,以及创造环境文明。

应该说,只有 1997 年,中国学术界引入了西方循环经济理论,以便将其引入中国,但 1999 年,中国环境保护总局当时开始在环境保护领域进行实验。

然而,改革和开放后,中国国内生产总值增长率迅速上升到前几年超过 10%,因此经济增长速度快。中国的资源和环境问题似乎有点明显, 在这种情况下, 肯定不足以推动循环经济只是在环境部门。因此, 在 2004 年, 国家理事会关于中国发展委员会的工作分配的领导, 以促进持续经济发展。因此, 从 2004 年开始, 中国将循环经济发展视为推动企业、公园和城市经济增长模式的经济增长模式。在这个领域实施经验和经验, 特别是与中国作为世界上最大的制造中心或制造基地。与此同时, 在 2009 年, 第三个世界的循环经济增强法案是制定循环经济法案, 我们称之为 “中国人民共和国的循环经济增强法案” 。这是德国和日本之后第三次通过法律, 以促进循环经济。

2010 年, 在十二五年计划中, 中国提出了更多工业、农业和服务的建议, 以促进循环经济的增长, 建立循环工业体系, 以促进绿色消费模式, 并将这些模式作为循环经济发展的中心。因此, 在 2012 年第十八次会议上, 中国在第十八次会议上提出了更多依赖于资源和循环经济的供应, 以促进经济发展模式的变化。2013 年, 理事会发布了中国循环经济发展战略和行动计划, 这是世界上第一个国家计划。至

于循环经济特别计划,2017 年, 中国在第十五个指南 “循环发展领导工作” 中发布了循环经济的战略指导原则。在动机时期之后, 政治人物认为循环经济是一个与可持续发展概念相匹配的经济模式。

在十九大里又进一步提出要构建建立、健全绿色、循环、低碳的经济体系就把它延伸到整个经济体系也就是说，在中国，政治人物在推动循环经济发展过程当中把发展循环经济作为推动经济社会绿色转型发展的非常重要的一个途径。 这就是循环经济在中国发展的 20 年。

本文提出了两个主要目标：一是引入循环经济的概念，二是探索循环经济模式的发展。

为更好地了解停工循环经济，了解中国保护停工循环经济的政治观点，本文共分三章。第一章停工周期经济学 事实上，所有的经济生产都来自大自然，但石油、煤炭、淡水等许多战略性经济资源并非取之不尽，甚至稀缺。总之，这种片面的经济思想与现实完全不符，违背自然规律。经济发展不仅要关注生产，还要关注人类福祉、经济效率和环境文明。以“收集生产废物”为特征的线性生产模型导致废物的单向流动。相比之下，闭环经济模型注重源头，从设计之初就避免浪费，并在整个制造过程中提供严格的跟踪和控制。本章通过阐明线性经济模型的局限性，重点关注新的发展模式，并详细说明其基本原理和主要目标。

第二章主要解释了为什么中国政府在确保经济快速增长和解决复杂环境问题的同时选择循环经济模式。除了明显的环境和社会因素外，中国领导人采取的一系列政治举措，主要是基于建设与环境文明和谐相处的社会理念。第一阶段发生在 1970 年至 1980 年间，在过去十年中，政府政策主要侧重于促进全面经济发展和循环经济试验模式。第二阶段从 1990 年到 2002 年实施，政府的目标是通过《纯生产促进法》减少和防止污染。第三阶段（2002-2008 年）是循环经济的示范阶段。即园区在过去五年中实施的主要地方城市、城市和行业。发布循环经济实验模型。

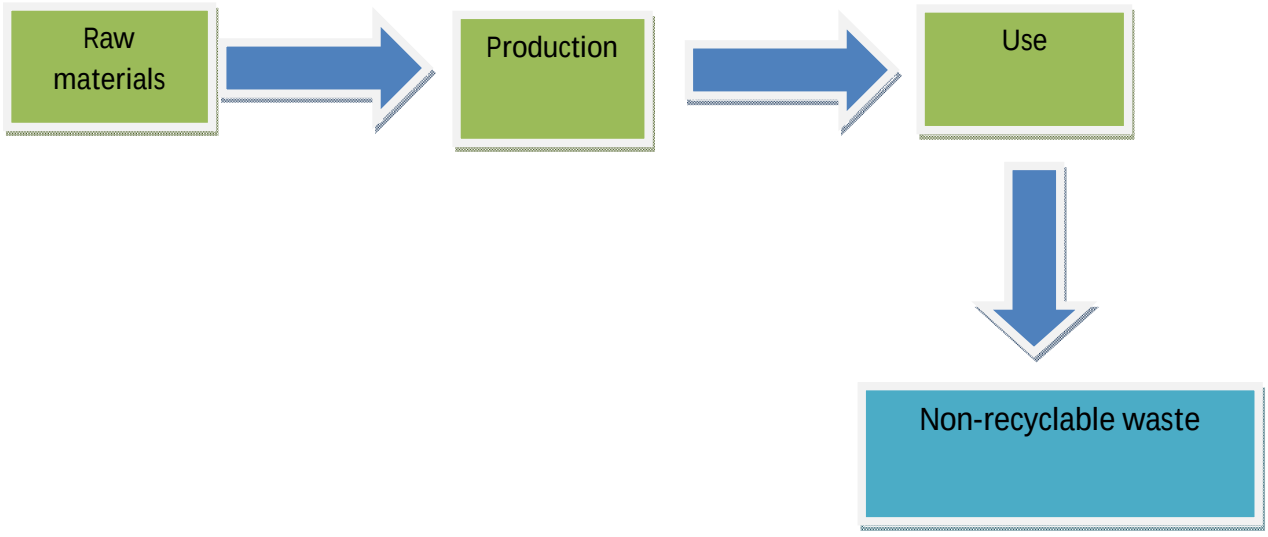
循环经济模式为中国提供了缓解经济发展与污染之间的紧张关系、消除绿色壁垒、让中国企业在改善国际环境方面继续获得竞争优势的途径。当然，由于经济动力不足、执法不力、缺乏先进技术、领导和管理不足、信息匮乏和信息不透明、公民意识不足，实施循环经济是一项重大挑战，这是解决改进现有措施，为现有问题提供适当的药物治疗。循环经济还是一个比较年轻的研究领域，本文希望通过对循环经济的回顾和讨论，更多地关注这种绿色发展方式。近期的一系列举措，即使目标更加宏大，甚至承诺遵守日益严格的国际标准，中国减少污染、提高能源效率的举措，无一不是针对中国，那就是更可持续发展的方向。

The context behind the circular economy

In February 2018 during an event organized by TEDxYouth@EEB3, C. Lohan, CEO of the Irish NGO The Green Economy Foundation, discussed the fundamentals of the circular economy and how it may truly transform the world for the better. C. Lohan explained that "*As humans we are constantly innovating and adapting and changing, but we are unique as a species therein all other species adapt to their environment, adapt to their habitat and alter so as to suit into that. With us as species we actually change our environment and our habitat so that it suits us better and we have been doing that over such a period of time that we have this unprecedented level of dominance on the planet that no other species before us has had and with great dominance comes great responsibility*" (TEDxYouth@EEB3 - Lohan, 2018). It is easy to argue that we have not been very good with that responsibility in terms of stewardship of our planet and its natural resources over the last few decades or centuries. Whether it is on purpose or out of ignorance, it is a problem that needs to be addressed. In order to do that, first we need to look at the current economic model that is commonly referred to as a linear model and to its limitations; then analyse the future scenario of our planet, especially with regard to the exploitation of natural resources and the prospects for economic and demographic growth in the long term to better understand the role that CE could play in it.

The linear economy

A linear economy follows the standardized "take- make- use- dispose" approach. This means that raw resources are collected (take), then turned into useful goods (make) before being consumed (use) and thrown away as waste (dispose).



This system stems from the Industrial Revolution and has remained the market's dominant model ever since. In this economic structure, value is created by manufacturing and selling as many items as possible, causing the linear economy to become unsustainable with a slew of issues that will have serious short, medium, and long-term consequences.

In a linear economy, the focus on sustainability is on eco-efficiency, which implies lowering the consequences on the environment while keeping the same output. This simply will prolong the time when the system is overburdened (Di Maio, Rem, Baldï, and Polder, 2017), instead of boosting the system's eco-effectiveness by minimizing its ecological impact.

This brings about the biggest issue within the linear economy: waste. To put it another way, in a planet with finite resources, the linear economy and its proclivity for wasting essential materials is a major problem. As stated by journalist Taylor L., the impact of these products being disposed of in landfills is multifaceted. To begin with, it implies that precious resources are being buried. This is not only wasteful, but it also has the potential to harm the ecosystem. Second, it requires more raw materials to be taken from the Earth, as well as more energy and water to create new materials and goods. Third, it promotes a consumer culture in which the worth of goods at the end of their useful lives is undervalued (Taylor L., 2020). Another reason to lessen our dependency on landfill waste is that it is becoming increasingly scarce. The growing recognition that we need to safeguard our finite resources and decrease emissions has sparked a drive toward a circular economy.

The world's population is rapidly increasing, and the planet's natural resources are depleting at an alarming rate. The expanding human demand for food, water, shelter, clothes, and recreation has a significant environmental impact. Many countries have chosen to convert from a linear to a circular economy for these reasons.

The future scenario

There are numerous scientific contributions to the circular economy (CE), even when considering that this concept has only gained momentum in the most recent decades. These do not include only economic studies, in fact the circular economy takes its cue from environmental sciences, biology and relies on information technology and numerous other sectors. Furthermore, the circular paradigm actively relates to the socio-economic and environmental context. Therefore, when looking at the future scenario of our economic system, we must take into account numerous elements.

In light of the scenario envisaged for the coming decades on a social, economic, energy and environmental level, it is inevitable to imagine and design new economic models that make it possible to minimize the negative impacts on the environment level, while maintaining a high degree of economic productivity.

The industrialization of the last decades has been defined by an approach aimed at maximizing profit through a linear production model addressed to the mass market. It resulted in an unrestrained increase in the growth of the population and, consequently, in the demand for goods and energy, significantly influencing the exploitation of resources and the deterioration of natural capital. In 2019 The Department of Economic and Social Affairs of the United Nations Secretariat analysed the long-term prospects of our planet in relation to some relevant issues, including: socio-economic development, climate change, biodiversity, resource-water, health, and the environment. The scenario analysed takes into consideration a time frame that ends in 2100 and

examines a potential future situation in the event of little or no political actions aimed at safeguarding and protecting the planet.

First and foremost, the topic of population increase is given special attention; as shown in Figure 1, the medium-variant prediction shows that the global population might reach 8.5 billion in 2030, 9.7 billion in 2050, and 10.9 billion in 2100, with the greatest growth rate measured in the developing countries and emerging economies of BRIICS[1] (UN, 2019).

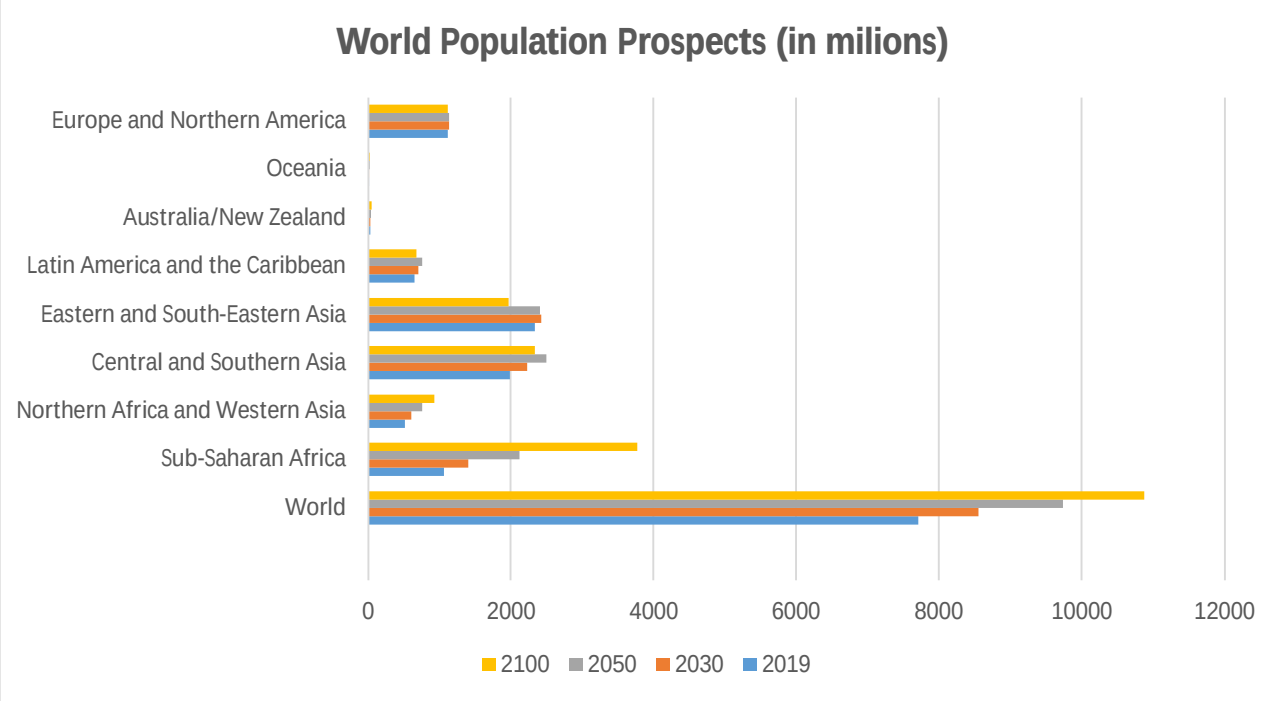


Figure 1 World population division, 2019-2100. Data Source: United Nations, Department of Economic and Social Affairs, Population Division (2019).

The data set out above has far-reaching repercussions if we think of the inevitable increase in overall market demand, particularly of water and energy.

With regards to the issue of energy, the main criticality consists in the fact that, in the absence of forward-looking sustainability policies, the future division of energy sources will remain unchanged compared to the current scenario (85% fossil sources - 10-15% renewable sources) (OECD, 2012). Unless clean, low-carbon, and affordable large-scale energy alternatives to fossil fuels are scaled up, the planet will continue to face two main problems: greenhouse gas emissions; and the lack of complete access to adequate energy for millions of people (Roser, M., 2020).

A climate crisis would put the natural world around us, our own well-being, and the well-being of future generations in jeopardy. The issues of global warming and climate change are strongly correlated with our lifestyles and with the energy needs of our economy. The risks are many and

[1] BRIICS is an acronym associated with the five major emerging economies of Brazil, Russia, India, China and South Africa.

they are mainly related to access to water, global hydrogeological instability, food production, land use and the deterioration of natural capital.

According to forecasts, the amount of greenhouse gas (GHG) emissions could have a significant increase by 2050 and this is mainly due to the increase in demand for energy (+ 80%) from the transport sector and global industrial processes (OECD, 2012). The consequences on the climate are significant since the scenario analysis proposed by the OECD predicts an exponential increase of CO_2 emissions that, as shown in Figure 2, account for about 76% of total GHG emissions. If uninterrupted, CO2 emissions would reach 530 ppm[2] by 2050. Given that the threshold within which there is a 50% probability of keeping the increase in world temperatures below 2°C is of 450 ppm or 430 ppm (for 1.5 degrees), the data above-mentioned is of particular importance because, in the event of failure to take corrective actions regarding the issues of combating GHG emissions, it forecasts an increase in temperatures between 3°C and 5°C (OECD, 2012).

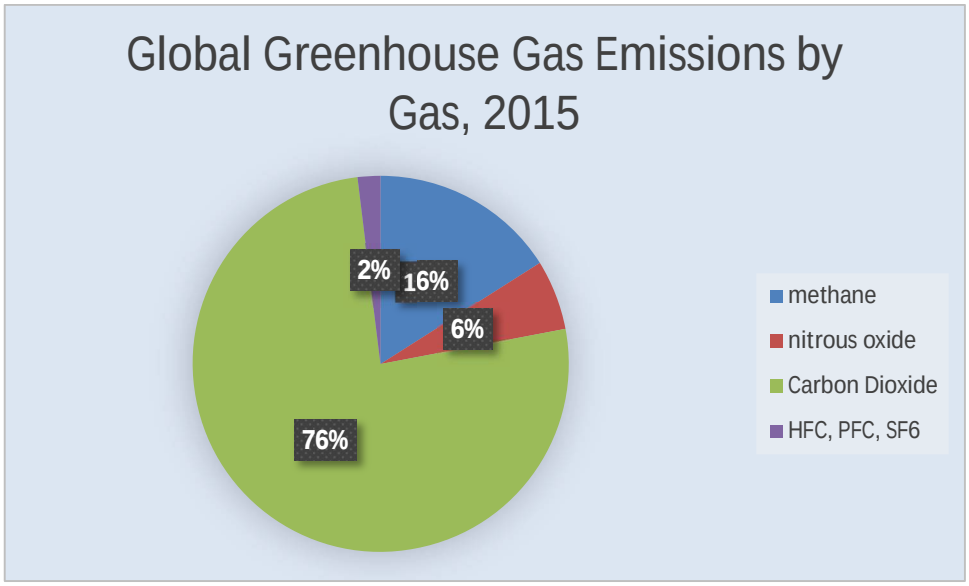


Figure 2 Global Manmade Greenhouse Gas Emissions by Gas, 2015. Source Data: Center for climate and energy solutions (2017).

As far as water resources are concerned, according to data from the Organization for Economic Cooperation and Development in 2050 almost 4 billion people (equal to about 40% of the estimated global population) will face problems in regard to access to water and management of water sources. As the manufacturing sector, electricity needs and household water uses will increase exponentially by 2050, overall water demand is expected to increase by 55% (OECD, 2012).

In light of the foregoing, it is essential to safeguard the numerous underground water reserves in the coming years, which have significantly reduced from 1960s.

[2] Ppm is an acronym for "parts per million".

We can see clearly that both the increase of the demographic ratio and the need for companies to respond to the growing market demand are elements that amplify the problem of resource scarcity.

Finally, air pollution is also a main concern for the health of individuals constantly exposed to the harmful substances in the air both in large metropolitan cities and in small provincial towns. As far as external pollution is concerned, one of the most dangerous substances is certainly the particulate matter (PM). In particular PM10 and PM2.5 are the two most harmful types of particulate matter, as they are so small that they can enter directly into people's respiratory ducts. To date, only 2% of the global population lives in acceptable conditions in relation to the concentration of PM10 in the air (OECD, 2012).

The levels of the main pollutants that form particulate matter are increasing sharply globally due to the social, economic, and industrial growth driven by the BRIICS economies and, more generally, by the emerging economies of the recent years.

Political and economic initiatives

In confirmation of what has just been exposed, there are numerous political and economic initiatives planned for the next decades in order to attempt a change of direction regarding environmental issues worldwide, starting from the improvement of the lifestyles of individuals up to the establishment of new national and international policies and a transformation in the economic approach.

The launch of the Sustainable Development Goals (SDGs) and the signing of the Paris Agreement, both in 2015, marked a significant shift in thinking about growth and development. They prioritized sustainable development and consumption as global efforts in order to achieve equal economic growth and fight climate change. The international community recognized in 2015, with the signing of the Paris Agreement on climate change and the establishment of the SDGs, that a shift in how we use natural resources is a precondition for achieving stable, safe, and resilient societies. Growth that is resource-intensive has a high environmental cost. Delivering the infrastructure and services needed to sustain rising economies and communities while also addressing climate change and preserving the stability of the ecosystem would need a paradigm shift in resource-use models.

The United Nations has set in its 2015 sustainable development 2030 agenda the objective of poverty eradication and sustainable development by 2030 world-wide. The introduction of the 2030 Agenda was a landmark achievement, setting up a shared global vision towards sustainable growth for all. In particular 2 of the 17 Sustainable Development Goals (SDGs) recall the CE model's principles in the way they express the will to promote sustainable economic models and infrastructures in the long term. Goal 9 states "*Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*", while Goal 12 states "*Ensure sustainable consumption and production patterns*" (UN, 2015).

The World Business Council for Sustainable Development has also analysed future trends regarding demographic, social, economic, and environmental variables over the long-term period until 2050 (WBCSD, 2010). The circular economy is clearly inserted as a tool to improve the well-being of people and the planet, as well as to achieve economic goals, in the new business agenda:

"Circular, closed-looped and networked designs that help people to live well and within one planet drive successful industry and reduce the need for primary resource extraction. Closed-loop systems make the concept of waste obsolete. They use waste as an input and resource, eliminating waste accumulation on land, in air or in water. Used products and materials can be reengineered to function again for multiple and distinct purposes or reduced to raw materials for manufacturing other products." (WBCSD, 2010, Chapter II, p. 7).

The role of a circular economy model

As can be seen from the political agendas mentioned above, the need of improvement in socio-economic conditions is explicitly asserted, testifying to a continuous search for progress and well-being of society as a whole.

The potential for more "circular", and sustainable, development models to deliver this transformation and unlock economic, social, and environmental benefits is generating a lot of excitement even in wealthy countries, where discussions of sustainability have tended to focus on supply chain restructuring rather than full-scale economic change.

Over the last decade, the CE has largely been promoted by high-profile transnational companies in consumer industries as well as waste management companies. There has also been a significant rise in business engagement, as businesses gradually see sustainable development as a significant feature in their long-term profitability and growth (OECD, 2016). The potential for cost savings by implementing more resource-efficient supply chains has prompted an increasing number of businesses to investigate circular approaches and discover new value in previously untapped waste streams. Ricoh, a global electronics corporation, for example, purchases, disassembles, and reuses printer, scanner, and other office equipment component pieces.

Against this background, the role of the CE in the rebuilding of a healthy system is emphasized as a core concept. However, transitioning to a circular economy is not easy. It entails more than just making changes to mitigate the detrimental effects of the linear economy. Rather, it is a structural change that promotes long-term resilience, creates market and economic opportunities, and benefits the environment and society.

As emphasized by C. Lohan, in a circular economy it is not simply about taking the linear economy and making it into a circle by simply doing more recycling. It is about a fundamental shift in how we think, how we behave and how we consume.

"So first of all, we need to shorten that line and in doing that we pull in from the side so that we stop extracting raw materials from the ground, and we stop producing waste at the other end, and then we bend the shorter line into a circle so that we have a completely different model and it's very much dependant on the use of what we call secondary raw materials. So, stuff that's already

in the system is being used. […] What this looks to us as users or consumers is a shift in our thinking and our behaviour. In particular we change our ideas of ownership. Instead of owning something we become users of services instead. […] As we move forward into the future, we can take the best of the past so that we have the resourcefulness, we have the design of products built to last and to be able to be repaired, we add that critical element of being able to retrieve raw materials from products that are no longer in use, and we have this change in ownership models. When we put all of that together we can still have an abundance and prosperity, but we can just have an increase in resourcefulness and that is the idea of the circular economy. That is where it becomes a transformative idea that can help change our story as we progress forward as a species."
(TEDxYouth@EEB3 - Lohan, 2018)

The concept of a circular economy

The 'circular economy' as a unifying term is unique in that it is all-encompassing. It combines several elements into a single framework to provide a more structured and comprehensive approach, allowing policymakers and businesses to better manage trade-offs related with resource efficiency initiatives. When the CE is applied correctly, it not only decreases waste and resource use, but it also unlocks potential value from natural resources. As a result, the CE involves more than resource conservation: it includes the development of an environment in which sustainability advancements sustain entirely new fields of economic activity.

Definition

The circular economy is a trending notion both among academics and practitioners. The CE does not have a standardized definition.

As it usually happens with trending notions, the CE has also diffused in its meaning. Critics argue that to different individuals it means a lot of different things and that there are various possibilities for defining it (Lieder & Rashid, 2016). Moreover, different terminology may be used for the concepts similar to CE, among them "closed loop economy" and "zero waste economy".

In an effort to cohere the concept, a 2017 study examined 148 articles that mentioned the term 'circular economy', with 77% of them also defining it. It resulted in a comprehensive set of 114 CE definitions, systematically analysed against a coding framework. As a result of the findings, CE was defined as "*an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling, and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. It is enabled by novel business models and responsible consumers.*" (Kirchherr et al., 2017, p. 221).

Although no universal definition of the concept exists in the literature both within and between schools of thought, among the 114 CE definitions, the most prominent is considered to have been provided by the Ellen MacArthur Foundation which reads: *"[CE] an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models.*" (Ellen MacArthur Foundation, 2012, p. 7).

This definition, according to the Kirchherr et al. (2017) research paper, is the most employed and, as such, will be the base reference in this thesis.

Aims

Generally speaking, a circular economy seeks to rebuild financial, manufactured, human, social and natural capital to ensure enhanced flows of goods and services through the 'value circle'.

When looking at it more specifically, the CE is frequently viewed as an operationalization process for businesses to implement the concept of sustainable development. Yet, Geissdoerfer et al. assert that the "*relationship between the concepts is not made explicit in literature*" (Geissdoerfer et al., 2017, p.757). This is further confirmed by Kirchherr et al. who assert that "*the main aim of the circular economy is considered to be economic prosperity, followed by environmental quality*" (Kirchherr et al., 2017, p. 221). In their coding, only 12% of the analysed definitions explicitly include notions of sustainable development and only 13% of coding refer to all three dimensions of sustainability at the core of a holistic view, meaning quality of the environment, creation of wealth, and social equity (WBCSD, 2017).

The most prominent aim of CE, as claimed by Kirchherr et al. (2017) is economic prosperity (46% of definitions), followed by environmental quality (37%–38% of definitions). Economic prosperity is most frequently mentioned by practitioners (53% of definitions) who view CE as a pathway to boost growth (Ghisellini et al., 2016).

Several authors such as Sauvé et al. (2016, p.54) claim that the CE concept largely neglects social equity. This is confirmed by Kirchherr et al.'s coding with social equity only considered in 18%–20% of definitions (2017).

Principles

CE is largely based on three principles, as outlined by the Ellen McArthur Foundation (2017):

- Design out waste and pollution.
- Keep products and materials in use.
- Regenerate natural systems.

Waste recycling and separation, industrial ecology, eco-industrial parks, and industrial symbiosis are all part of the CE's legacy. Various concepts, such as waste hierarchies and the 3R and 4R frameworks, date back to the 1980s. More specifically, the 3R's concept has become commonplace among regulators all over the world.

Only 3–4% of definitions reflect the 4R framework, which is the official EU policy framework for CE addressing reduction, reuse, recycling, and recovery (Kirchherr at al., 2017). As shown in Figure 3, in the Kirchherr et al. research paper recycling has been found to be the most common component in the definitions examined (79% of definitions), followed by reuse (74%–75% of definitions) and reduce (54%–55% of definitions) (Kirchherr et al., 2017). Reduce, reuse, and recycle (the 3R framework) are the most frequently used in the overall survey (35 percent–40 percent of definitions).

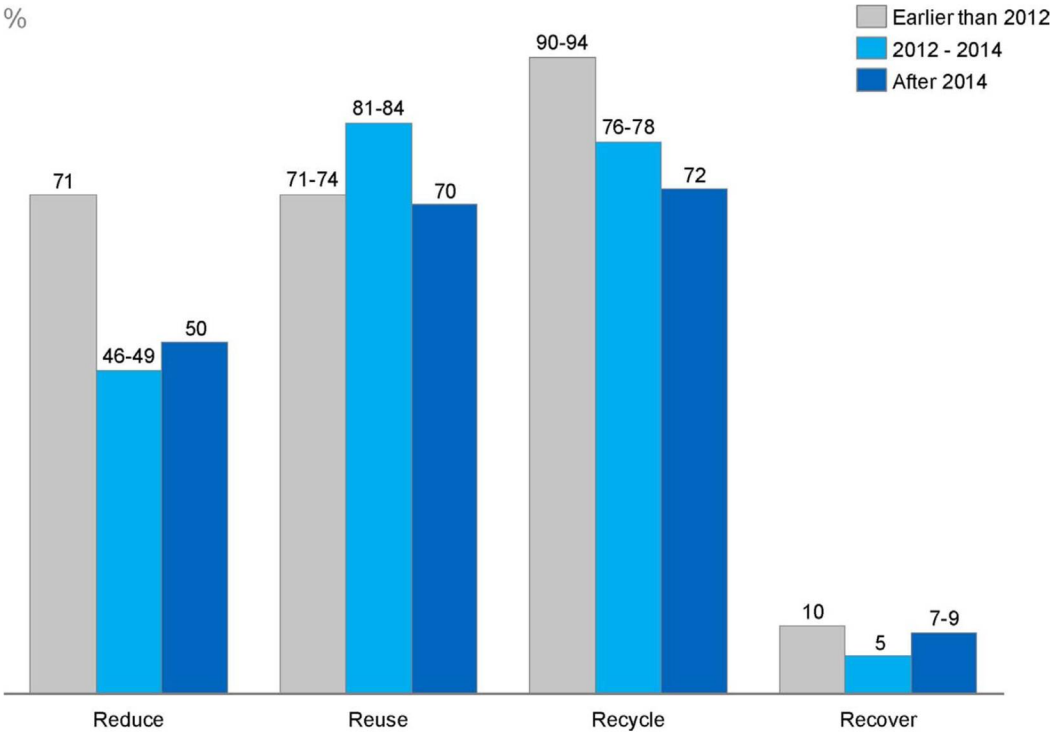


Figure 3 Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling, 127, p. 226.

The systems perspective is hypothesized by the Ellen McArthur Foundation to have replaced the R framework, with Charonis G.-K. writing that CE "*is understood as a system that is designed to be restorative and regenerative*" (2012, p.2). Since early 2012, there has been a major focus on this viewpoint: prior to 2012, 29 percent of meanings included this perspective, compared to 47 percent from 2012 onwards.

The macro-system is the subject of most concepts that have a systems perspective. For example, Yuan et al. (2008, p.5) notes that CE "*requires complete reform of the whole system of human activity*". However, in definitions from 2012 or later, the meso-system viewpoint, as illustrated by Conticelli and Tondelli (2014), which focuses on eco-industrial parks, is even more prevalent than the macro-perspective, suggesting that CE is now increasingly seen as a regional effort. Only few definitions, such as Linder et al. (2017), mention that CE necessitates structural changes in the micro, meso, and macro systems at the same time, an explanation we find useful in emphasizing the holistic systemic reform that CE necessitates, as stated in a recent webinar facilitated by the Ellen McArthur Foundation in July 2020 (Ellen McArthur Foundation, 2020).

Origins of the circular economy concept

Circularity is a notion with deep intellectual and historical roots. The principle of feedback, or cycles in real-world processes, is centuries old and has echoes in a variety of philosophical schools.

After World War II, computer-based studies of non-linear systems reignited CE in advanced nations, revealing the intricate, interconnected, and unexpected character of the world we inhabit.

The first economist to analyse the development of the circular production model, calling it “cowboy economy” in a long-term perspective was Kennet E. Boulding, who in his famous essay "The Economics of the Coming Spaceship Earth" wrote: “*The closed earth of the future requires economic principles which are somewhat different from those of the open earth of the past. […] I am tempted to call the open economy the "cowboy economy," the cowboy being symbolic of the illimitable plains and also associated with reckless, exploitative, romantic, and violent behaviour, which is characteristic of open societies*.” (1966, p. 12)

In this excerpt, the contrast between the linear production model, defined as the "*cowboy economy*" by the author, is exhaustively defined to the extent that it determines an unsustainable exploitation of resources in the long run in order to maximize profit, and the alternative circular production model, called "*astronaut economy*" in relation to the need to minimize the use of raw materials and attempt to regenerate a system that is functional to the maintenance and protection of resources.

The ground-breaking 1972 book “The Limits to Growth”, written by sustainable development pioneers Dennis and Donatella Meadows, with co-authors Jørgen Randers and William W. Behrens III provides arguments about sustainability. More particularly, it emphasizes that economic expansion and an expanding global population will eventually collide due to rising natural resource costs and environmental damage (Meadows, D. et al. 1972). The publication of "The Limits to Growth" was a thought-provoking essay that sparked a number of debates about environmental devastation at the cost of continued economic growth.

Already from the second half of the twentieth century onwards, some professors and businessmen questioned the possibility of creating value by safeguarding the environment and natural resources. From this moment in the literature there are innovations of thought that outline the circular model in an ever more precise way, coherently with the socio-economic changes that have occurred over the years, up to the present day.

Numerous schools of thought have since advanced this general interpretation. Among these environmental economics (Pearce and Turner, 1990), industrial ecosystems (Jelinski et al., 1992); cleaner production (Stevenson and Evans, 2004); product-service systems (Tukker, 2015); biomimicry (Benyus, 1997); the performance economy (Stahel, 2010); eco-efficiency (Haas et al., 2015); cradle to cradle design (Braungart et al., 2007); regenerative design (Lyle, 1996) and industrial ecology (Graedel and Allenby, 2003).

Pearce and Turner were the first to present the theory of circular economy. In their "Economics of Natural Resources and the Environment," they present the principles inside and across natural resource economics, as well as their relationships and repercussions for understanding how economics works (1990). The authors go into detail about the environment as an input as well as a waste receiver. They believed that conventional economies were designed without a built-in inclination to recycle, and that the ecosystem was viewed as a waste reservoir. However, Earth must be viewed as a closed economic system, with the economy and ecosystem interconnected in

a circular instead of just linear manner (Boulding, 1966). They suggested a closed-loop of materials in the economy to create a win-win situation for both the economy and the environment.

Schools of thought

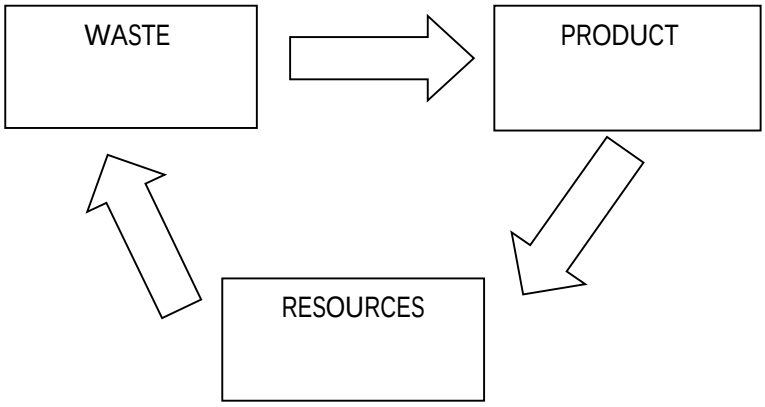
Several major schools of thought are blended in the circular economy model. The Ellen McArthur Foundation highlights Walter Stahel's functional service economy (performance economy); William McDonough and Michael Braungart's Cradle to Cradle design philosophy; Janine Benyus' biomimicry; Reid Lifset and Thomas Graedel's industrial ecology; Amory and Hunter Lovins and Paul Hawken's natural capitalism; and Gunter Pauli's blue economy systems approach; and the regenerative design approach by John T. Lyle (EMF, 2017).

We will focus on the most prominent ones: Cradle to Cradle, performance economy, industrial ecology, natural capitalism and regenerative design.

Cradle to Cradle

The Cradle to Cradle (C2C) idea was created by German chemist Michael Braungart and American architect Bill McDonough. This design philosophy tries to avoid the creation of waste thanks to the design of regenerative systems capable of exploiting resources that have already been used to insert them into a second production cycle in order to transform them into a new good.

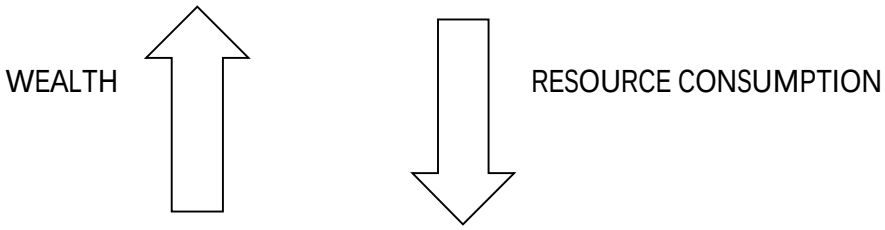
The core principles of the C2C concept can be summarized in “Waste equals food” by creating products and materials with long life cycles that are safe for human health and the environment, as well as the ability to be reused indefinitely through biological and technical metabolisms and create and recovering the value of these materials after their use.



Performance economy

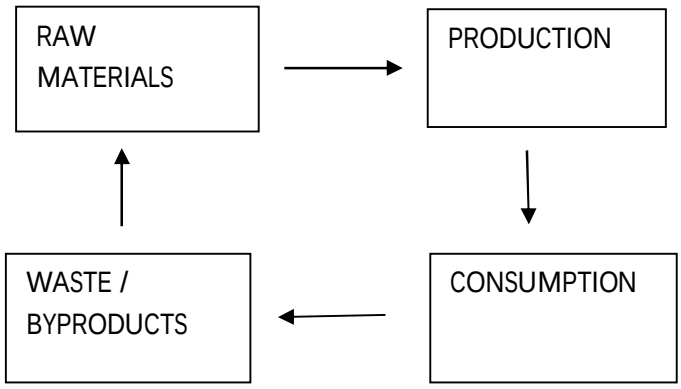
In his 1976 research report to the European Commission, "The Potential for Substituting Manpower for Energy," co-authored with Genevieve Reday, industrial economist Walter Stahel outlined the perspective of an economy in "loops cicles" (or circular economy) and its impact on employment creation, productive capacity, resource savings, and waste minimization. Stahel focused on creating a "closed loop" approach to manufacturing. Material life extension, long-life products, reconditioning operations, and waste reduction are the four key objectives it pursues. It

also emphasizes the importance of selling services rather than goods, a concept known as the 'functional service economy,' which is now more commonly referred to as the 'performance economy.'



Industrial ecology

This approach states that is necessary to consider the industrial ecosystem as a natural ecosystem. It leads to an improvement in waste management, the use of resources and end-of-life materials with the goal of establishing closed-loop systems that use waste as an input. Industrial ecology focuses on social well-being as well as natural resource regeneration. The terms "industrial metabolism" and "industrial symbiosis" are incorporated.



Natural capitalism

In their book "Natural Capitalism: Creating the Next Industrial Revolution", Paul Hawken, Amory Lovins and L. Hunter Lovins define a global economy in which business and environmental interests collide, acknowledging the interdependencies that exist between human-made capital development and use, as well as natural capital flows. The following four principles underpin natural capitalism: increase the productivity of natural resources; shift to biologically inspired production models and materials; "service-and-flow" business model; reinvestment in natural capital.

Regenerative Design

John T. Lyle, was the first to introduce the idea of a regenerative design that could be applied to all systems, meaning that any existing system can be managed in a regenerative way by creating the conditions for the activities that constitute it to be able to produce the same sources or materials that were used during the production process . He is widely credited with laying the groundwork for the circular economy framework, which was further developed and popularized by McDonough, Braungart, and Stahel.

Challenges

Transitioning to the CE will present various challenges and opportunities depending on each country's stage of growth, resource endowments, and political institutions. Capacity and financial limitations, economic and structural dynamics, and an infrastructural deficit, combined with continued urbanisation, would require customized policy responses that, more often than not, are difficult to replicate from country to country.

When we look at these constraints from a broader perspective, we can see that there are three primary underlying characteristics that represent significant barriers to developing a Circular Economy.

First, the redesign of economies in line with circular value chains would entail substantial **investment** in innovation and financial access to make it inclusive and sustainable. It would also involve investing on the development of strong governance structures to reduce the health and environmental risks associated with poorly managed waste management and manufacturing activities.

Second, for decades to come, **low-income countries** will continue to undergo rapid urbanization, necessitating the use of primary resources to bridge the infrastructure gap. Unlike developed countries, developing countries have few in-use buildings and materials that can be reused. Consumer demand is expected to increase as well; experience from developing and emerging countries indicates that new products and individual ownership would be favoured over 'second-hand' goods and asset-sharing (Preston et al., 2019).

Finally, because a variety of materials lose their qualities over time, **100 percent recyclability** and infinite reuse and recycling are not achievable. As a result, goods are downcycled at some stage during their subsequent economic circulations before being discarded (Milios, 2018).

Benefits

Transitioning to a CE would allow countries to gain the advantages of industrialization, promote well-being, and lessen vulnerability to resource, economic, and environmental disruptions while preserving limited natural resource sources and preventing environmental degradation (Preston et al., 2019).

The CE and the opportunities it presents are often discussed through a developed-country approach, ignoring policy objectives unique to low-income countries. In Western countries, for example, the opportunity for health benefits has not been a major focus of CE policies. However, in developing countries where primary healthcare coverage and better health outcomes are important objectives.

Generally speaking, The CE has attracted a lot of attention because of its ability to address a range of advantages:

- Improved **waste management** and decreased **waste generation** that will help to minimize the number of people who die prematurely as a result of open waste burning, which is estimated to kill 270,000 people per year (Kodros et al., 2016).
- **Job creation**. Many expect the CE to drive job creation and economic growth by capturing the value of materials that were previously lost to the economy and creating jobs to build on that value. Most macroeconomic models expect that such a change will be beneficial to the economy, and that many CE activities will provide work opportunities across a wide spectrum of ability levels and geographies. According to a 2015 report by the Waste and Resources Action Programme (WRAP), switching to a CE could result in up to 3 million additional jobs in Europe by 2030 (WRAP, 2015).
- **Balance-of-payments support**. According to a number of reports, the potential savings from converting to a CE may be in the billions or trillions of dollars. According to a McKinsey report for the Ellen MacArthur Foundation, EU manufacturing sectors could save up to $630 billion per year in materials costs by 2025 (EMF, McKinsey, 2015). According to an Arup research for the Ellen McArthur Foundation, switching to the CE on a big scale in China may save enterprises and households RMB 70 trillion ($10.4 trillion) by 2040, equivalent to 16% of China's projected real GDP (Arup, EMF, 2018).
- **Supply chain resilience**. Fears of resources 'running out' have faded as resource prices have declined, but price volatility remains a powerful incentive for both resource-importing and resource-exporting countries to pursue less resource-intensive economic paths. Furthermore, in recent years, there have been increasing worries about advanced technology's dependence on essential material supplies, such as rare earth elements for smartphones or cobalt for electric vehicles (Mathieux, 2017). These resources are contained in a few producing nations, many of which lack suitable resource governance structures to mitigate the environmental and socioeconomic risks of mineral extraction. Circular value chains and product sharing and reuse models are intended to reduce countries' exposure to resource supply risks (European Commission, 2015).
- **Climate change mitigation and adaptation**. According to a recent study by Material Economics, transitioning to a CE could reduce EU heavy industry emissions by up to 56% by 2050 compared to a baseline scenario (Material Economics, 2018). As per the International Resource Panel (IRP), more resource-efficient techniques may be critical to meeting the Paris Agreement's commitments. According to the IRP, resource efficiency management policies could reduce greenhouse gas emissions by 60% by 2050 (Ekins et al., 2017). Individual resource savings can be even bigger: processing aluminum from scrap reduces energy inputs and greenhouse gas emissions by 90–95 percent (Gardner, 2017). CE actions that can help with climate adaptation and recovery include more efficient use of water and energy resources, effective governance of land ecosystems to avoid climate-induced losses, and innovative solutions to infrastructure development. Exploiting the synergies between CE and climate mitigation and adaptation will be critical to meeting global commitments under the Paris Agreement while lowering the costs of building climate-resilient infrastructure and industry in the

short to medium term, with middle- and lower-income countries expected to bear the brunt of climate change's effects.

To galvanize buy-in and collaboration across ministries, proponents of the CE should use it as an organizing framework that is mainstreamed across government policies and sectoral plans, demonstrating how CE values and practice can be used to facilitate the implementation of current national development targets as well as the objectives of industrial strategies.

Implementation efforts

The concept has been adopted globally and at various stages, ranging from government initiatives to business-led initiatives, with the EU and China at the vanguard of this transformation on a global scale.

Over the last two decades, the CE policy scene has changed significantly.

Currently there are many initiatives underway to implement circular economy. Legislative and regulatory bodies, NGOs, and consulting firms are the key drivers of this shift. At the same time, no common ground for the variety of existing approaches has been established (Kalmykova et al., 2018).

The rapid degradation of the environment around the world has prompted the implementation of policies aimed at reducing the negative environmental effects of production and consumption. There are several potential for value creation through a transition to the CE, ranging from waste recycling and machinery repair in agriculture to remanufacturing in the textiles industry to durable design in construction.

A number of countries have established legislation to implement the recycling idea of the circular economy. Germany has been a forerunner in this regard, having started promoting the CE in 1996. The law known as the "Closed Substance Cycle and Waste Management Act" was enacted in accordance with this. The legislation establishes a mechanism for implementing closed-loop waste management and ensures eco - friendly waste disposal as well as waste assimilation capacity. Japan is another nation that has attempted to introduce CE early. The Japanese government has established a detailed legal structure to guide the country's transition to a “recycle-oriented society” (Morioka et al., 2005). The 'Basic Law for Establishing a Recycling-Based Society,' enacted in 2002, establishes quantitative recycling goals as well as long-term dematerialization goals for Japanese society (Van Berkel et al., 2009). The purpose of both countries' CE policies is to prevent future environmental damage and conserve finite resources by implementing effective waste management, particularly solid waste management (Su et al, 2013).

China is the third country to undertake significant attempts to implement CE on a large-scale basis. However, unlike the German and Japanese governments, the Chinese government first implemented the CE system on a smaller scale through a series of pilot studies in the short to mid-term, in order to provide a stronger basis for evaluating the larger scale and maximum coverage in the long run.

Several other nations, such as Sweden, have also had various incentive programs in place for a long time. They have also tried to use public education to establish the best conditions for a steady and successful rise in recycling rates. The policy was a success, and both politicians and environmentalists were satisfied with it.

Sweden, Germany, and a number of other European countries have effectively incorporated green political parties into their political structures and decision-making processes, promoting and supporting the transition to a circular economy.

Financial incentives, such as reduced VAT[3] on repaired goods, and regulations, such as labelling systems, have been used in developed countries to encourage customers to select more 'circular' products. Although the majority of policy action in this field has arisen in developed countries, some of these initiatives are already in use in developing countries: extending producer responsibility (EPR) policies, for example, have been widely adopted in emerging and developing countries. China, Colombia, India, Nigeria, and Thailand, and the governments of Indonesia and the Philippines are considering them for plastic waste management.

Despite the excitement surrounding the CE as a new development approach, deployment has been gradual. Regardless of the fact that many countries have increased their energy efficiency and resource productivity, global resource consumption has not decreased. Indeed, recent trends suggest that GDP growth can be 'recoupled' from resource use (Ekins and Hughes, 2017). According to a study of material use in the global economy, only 9.1% of the 19.4 billion tonnes of waste generated in 2015 was recycled (De Wit et al., 2018).

The CE is gaining momentum on the foreign policy agenda, but there is currently no global agreement in place to direct implementation, align the CE with existing systems, and promote collaboration and rapid lesson sharing.

[3] Value Added Tax (VAT): a broad-based, general consumption tax levied on the added value of goods and services. In some countries it is known as a goods and services tax (GST).

The Origins of the Circular Economy in China

China's director for circular economy Yang ChunPing, interviewed by the Ellen McArthur Foundation's Joss Bleriot during the 2018 Summit, emphasised that for China, the circular economy is not environmental legislation, but an economic, systemic, and developmental model that stems from the country's special conditions. In fact, the CE was introduced in the middle of industrialization, while other countries started it when their industrialization had already reached its maturity. As a result, alongside industrialization and economic development, CE policies have evolved and have been implemented with successful results (Ellen McArthur Foundation, 2018). This also stems from political support systems. Political leaders, and the State Council's most influential departments—especially the National Development and Reform Commission and its predecessors—have always been supporters of the CE, particularly for resource-oriented policies. The political support assists in the engagement of additional government departments that are related to the CE, as well as the coordination and mobilization of resources between those agencies. Local bureaucrats rarely have any incentive to behave against the CE in policy enforcement because the CE is usually consistent with the local economic development needs.

The government has been making considerable effort to transform the CE from an economic growth policy into a nation-wide, full-scale practice to address environmental issues.

In retrospect, China's policy-making efforts for a circular economy have been long-term and gradual, resulting in a diverse set of relevant policies and state actors. The development was aided by a top-down approach and the incorporation of international and academic experience.

Policymaking has benefited significantly from expertise gained from foreign interactions, in addition to proactive initiatives by state actors. The CUR was taught to China by the Soviet Union; cleaner production was aided by the United Nations; and EPR has a European origin. However, state actors played an important role in their adoption and assimilation process. They responded to new concepts and practices on a global scale and incorporated them into domestic policies. The rapid learning phase that began in the 1990s coincided with China's willingness to participate in the global economy and affairs, allowing for a fast and clear learning process.

The policy instruments used are domestic in nature and dependant on demonstration projects to inspire leading practitioners and then promote information dissemination. One of China's CE's advantages that has long been recognized is its wide reach (McDowall et al. 2017), which is the result of long-term, gradual efforts enabled by constructive state actors and their learning from international society. Other industrializing countries that want to use a CE to manage industrial growth and environmental protection may be able to learn from China's experience and make a faster transition.

Nonetheless, the full transition remains difficult to achieve as China's policy-making process entails the government's commitment, cooperation among state actors, and proactive learning from smart practices (Zhu et al, 2019).

Background

In China's major philosophical traditions, thoughts on environmental respect and the importance of human-nature harmony have always been expressed (Ying et al., 2016). Confucianism advises men to live in accordance with nature and to honour the "discipline of nature" (自然纪律 ziran jilu) and Taoism quotes the " following nature " (顺其自然 shunqiziran). By focusing on holism and everyday ecological activities, Buddhism provides a variety of ecological ideas (Ying et al., 2016).

The idea of human-nature harmony was shattered under Maoist rule and strong industry-oriented economic policies The People's Republic of China's return to world politics in the 1970s and participation in the first global environmental summit in Stockholm in 1972 provided more momentum for environmental policy development than a rising awareness of the country's ecological challenges (Betke, 2003 p. 774). In fact, domestic environmental issues have ranked low for several years as a result of China's open-door policy, which has fuelled the country's economic growth since 1978. Although basic environmental protections were in effect, regulatory provisions were typically poorly implemented. The lack of an appropriate enforcement system is primarily to blame, according to the literature on the subject (Ran, 2013).

As strong economic growth persisted throughout the first decade of the new Millennium, social and environmental issues became more intense, leading to increased public awareness as well as increased awareness among state and party officials. NGO's that focus on advocacy helped to advance sustainable development viewpoints at various levels.

In 1997, 2002, and 2012, China released national reports on sustainable growth. In China's economic and social transition, the word "可持续增长 Ke chixu zengzhang - sustainable growth" remains a key feature in discourses. This word was coined by the government, notably the National Development and Reform Commission (NDRC), to stress the scope of its responsibility in managing economic, social, and environmental development processes. The business field, as in other countries, refers to this principle in the light of increasing attention paid to CSR[4] strategies. Since it provides a holistic approach to development and is a commonly cited term in international cooperation, NGOs have also adopted it.

At the 17th and 18th Party Congresses in 2007 and 2013, respectively, the Chinese political leadership boosted efforts to promote the principle of sustainable development, as well as home-grown ideas relating to environmental and climate security, stability of the society, and more modest economic growth. (Kuhn, 2016).

Since 2007, the Chinese Communist Party has advocated the idea of ecological society as a long-term vision of sustainable development, is one of the key aspects of ecological civilization and harmonious production. As a result, the idea of a CE has become a key topic in China's environmental political discourse.

[4] Corporate social responsibility (CSR) - a form of private international company self-regulation.

Immediate environmental difficulties, resource constraints and scarcity, potential high competitiveness in foreign commerce, and overall well-being gains of CE in the short term and long term all support the new nationwide development strategy. All in all, the urgent environmental and resource situation in China, as well as the prospective long-term implementation benefits, are the primary reasons behind the Chinese government's decision to adopt CE.

The plan entails substantial changes in education, technology, and regulations and the challenges are significant.

The economic revolution

The year 1979 marked the beginning of the economic revolution. Mao Zedong and the Communist Party had planned and centralized China's economy up to this point. The state set production objectives, resource allocation, and pricing levels, and large-scale investments were made to ensure rapid industrialization: by the end of the 1970s, state-owned businesses produced the majority of industrial output.

Free competition, private intervention, and foreign investments were prohibited, and trade with other countries was restricted to just those items that could not be manufactured or obtained on Chinese land, or those from countries in the Soviet bloc.

Mao Zedong died in 1976, and Deng Xiaoping, his successor, was the one who began the reconstruction and reformation of China's economy. In 1979 the requirements of the Four Modernizations were spelt out with unprecedented clarity at the Third Plenum. Because the fight against Lin Biao and the Gang of Four had now been declared a success, the plenum decided that the Party's work should be shifted to socialist modernisation. Since 1979, he has implemented a series of economic and financial policies aimed at breaking the former Soviet-style policies and embracing free market principles in order to increase economic growth and living standards by opening trade with the West.

The reconstruction began with farmer incentives and the establishment of special economic zones on the cost side, with the goal of attracting foreign investors and importing high-tech items to fill in the gaps in Chinese technological progress. The annual gross domestic product (GDP) data clearly showed the impact of the economic improvements. According to the Chinese government, annual GDP increased by 6.7 percent from 1953 to 1978, while many economists believe the figures are overstated by the government, with a more realistic estimate of 4.4 percent.

Despite persistent differences among the leadership over the appropriate pace of economic transformation, a consensus formed in 1981 that without a rigorous plan for population control, China, like a number of other emerging countries, would gobble up whatever material gains it may make. There had been two earlier censuses in the PRC, one in 1953 and one in 1964, but neither had been closely watched, and the leadership knew that knowing the actual amount of China's population and the rate of its growth was vital for making wise planning for the future. As a result, a date was established for a full national census: July 1, 1982. The census findings confirmed what

Chinese demographers and planners had predicted: China's population had surpassed 1 billion people.

By the late 1980s, the PRC's government had to manage a billion people, manage foreign contracts worth billions of yuan, completely restructure its economy, and rebuild its shattered schools and universities into places where intellectual and scientific research could flourish at international standards.

It was allowed to criticize Mao Zedong in the PRC by 1982. The general agreement was that he had been a great leader during the early years of the revolution, but that his policies had become erratic and at times disastrous after the Great Leap. Economic growth became the centre of attention, with only the speed and intensity of expansion being debated. Following the first burst of economic optimism in 1979 and the massive trade deficit that occurred in 1980, the years 1981 and 1982 saw a more cautious approach to development, as advocated by party senior Chen Yun. Investments were reduced, many expensive foreign contracts were terminated, the domestic budget was reduced, and the trade deficit was reduced.

The reforms caused the economy to overheat, resulting in unemployment, inflation, and trade deficits, prompting the more conservative faction among Chinese leaders to seek a second period of retrenchment.

Whether the pace of change was accelerated or slowed, one reality remained indisputable: the Chinese government had now voluntarily entered a world in which law, in all of its complexities, would have to be studied, understood, and applied. The training of attorneys, the nature of tax law, the enforcement of family law, and the study of international law were the four key topics addressed. This further allowed China to increase its competitiveness.

China's GDP has increased by 10% year since 1979, implying that Chinese growth has doubled every eight years. China was not immune to the worldwide economic downturn of 2008 and lost some of its competitive edge. Chinese GDP growth fell from 14.2 percent in 2007 to 9.6 percent in 2008 to 9.2 percent in 2009, but the crisis was met with a massive monetary policy and the implementation of a significant set of economic stimuli, resulting in an increase in domestic investments, especially in science and technology, and consumption.

The phase of, as called by Thomas Heine from China Baden Business Development Company, the Reform and Opening (1979 – 2012) was mainly factory driven and investment driven (ENRICH in China, 2019).

The growth drivers can be summarized as such:

- low- productivity farm workers causing a leap in productivity in the cities;
- catching up growth as late comer (learning curve effect);
- availability of workers in labor market, high saving rate, liquidity for investments;
- opening and reform and WTO accession for (inter-) national investment activity;
- institutional reforms setting off market and entrepreneurial impulses.

Agriculture, trade, and services became more competitive, efficient, and market-oriented as a result of a sharper reallocation of resources to provide them in sectors that were heavily state-controlled prior to Deng Xiaoping's reforms. This favourable market situation integrated new techniques and technological advancements, and international investors, who were now extremely welcome, did not miss the opportunity.

Clearly, if a combination of these variables was responsible for China's economic awakening, the same factors are responsible for the country's current predicament.

The internal driving forces

According to the analysis conducted by numerous scholars, the internal driving forces that led the Chinese government to evaluate the circular economy as a new mode of development can be divided into two categories: social and environmental motivations, and a gradual change in the governmental philosophy on environmental issues.

Social and environmental motivations

Since the 1980s, the effects of the economic growth described above have begun to have a negative impact on both society and the environment, on the one hand by exacerbating regional and social inequalities, on the other by causing serious environmental, economic and social damage within same cities. In addition to the problems concerning social injustices, the policy of economic growth has also entailed the formation of inadequate social and economic safety nets, problems of corruption and mismanagement, consequently increasing the risks of social and political disorder.

In recent years, China's rapid economic expansion has elevated it to one of the world's most significant economic institutions. It has, however, also caused significant depletion of resources and environmental damage, resulting in a *contradiction* (Li et al. 2010) in the following aspects:

- China’s resources per capita are scarce and its **resource-utilisation** efficiency is relatively low, causing a rapid increase in the demand for them.
- China's **environmental condition** has deteriorated. This stems from a range of factors related to land erosion, desertification, deforestation, water scarcity, air pollution, biodiversity loss, and waste generation (Heshmati, 2015).
- the country's overall **energy consumption** has increased fivefold and, consequently, greenhouse gas emissions have increased rapidly.

On the demand side, beginning in 2002, the economic boom and heavy industry production have been dragging up the consumption of various resources and energy. To address the contradictions between economic development and environmental security, the circular economy has been confirmed as a basic state policy in China.

The CE is a different way of addressing the significant resource deficit and supply shortages that exist in relation to the population and market structure. In comparison to international standards, China's resource utilization efficiency (defined as resource consumption per unit of GDP) is low.

Contributing for 14.5 percent of the world's economy (on a purchasing power parity basis), China, in 2005, used 15.8 percent of the world's freshwater, 26 percent of steel, 25 percent of aluminum, and 47 percent of cement. In 2011, it used more raw resources to create 46 percent of global aluminum, 50 percent of global steel, and 60 percent of global cement than the 34 nations of the Organisation for Economic Co-operation and Development (OECD) combined: 25.2 billion tonnes in total. Concerns about China's resource-intensive and pollution-intensive growth path prompted a push for a more sustainable development model (Mathews et al., 2016). In China, 2.5 kilograms of materials are needed to produce $1 of GDP, compared to 0.54 kilograms in OECD countries. In 2014, China generated 3.2 billion tonnes of industrial solid waste, with just 2 billion tonnes being recycled, composted, incinerated, or reused. In 2012, businesses and households in the European Union's 28 member states produced 2.5 billion tonnes of waste, 1 billion of which was recovered or converted to energy. China is projected to generate about a fifth of the world's urban solid waste by 2025. (Hoornweg et al., 2013).

According to data from the Energy Information Association (EIA), China's overall carbon dioxide emissions keep increasing, and the numbers have risen significantly from 2000 to 2018. China's share of global carbon dioxide emissions rose from 10.6% in 1990 to 21.1% in 2007, according to the EIA.

The high dependency on energy-intensive manufacturing and coal as a primary energy source contributes to the high emission rate. Since 2005, installed coal fired power capacity has quadrupled, from 222 gigawatts (GW) in 2000 to 1 007 GW in 2018. This is mostly due to the installation of bigger and more reliable supercritical and ultra-supercritical facilities. As a consequence, average coal plant efficiency increased from 30% in 2000 to 39% in 2018, rendering China's coal fleet one of the most efficient in the world.

Despite this, subcritical plants continue to account for a significant portion of China's coal fired power capacity and CO2 emissions. Emissions of co2 from coal-fired power stations hit 4.6 gigatons (Gt) in 2018, exceeding the EU and Japan's combined emissions from fossil-fuel burning, as seen in Figure 4 (EIA, 2020).

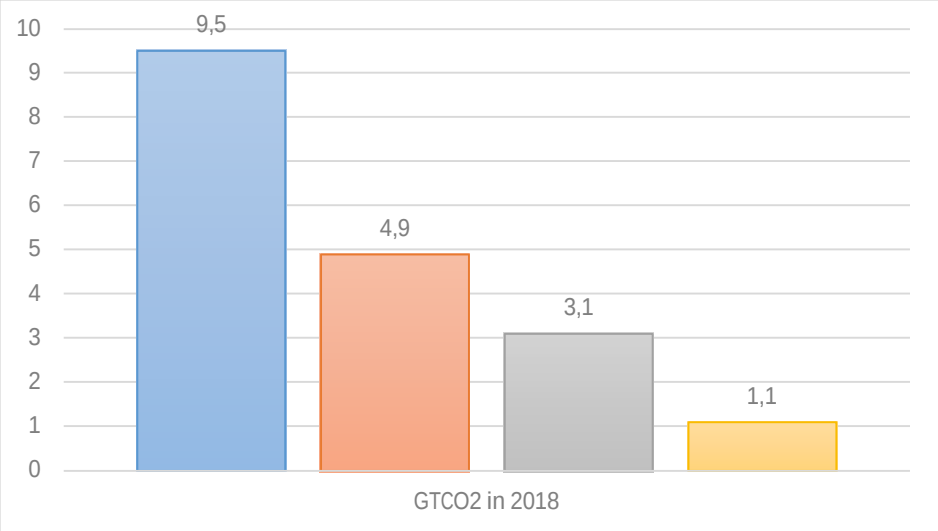


Figure 4 CO2 emissions from fossil-fuel combustion in 2018. Data Source: IEA- International Energy Agency, China's Emissions Trading Scheme (2020).

The significant lack of capital and energy to meet rising demands and a high rate of economic growth continuously pushes for the incorporation of CE in order to find a path to long-term development (Li et al., 2010).

According to preliminary data from the International Energy Agency, China's energy consumption has more than doubled over the last two decades, and it has surpassed the United States as the world's largest energy consumer. Since high-energy and resource-consuming industries will continue to dominate the Chinese industrial system in the future (Li et al., 2010), a path of sustainable economic growth will be the only option open to China.

The shortcomings of institutions and policies are a significant cause of these environmental and resource issues. Low resource efficiency and severe pollution are the products of extensive market and policy failures, including raw material subsidies, poor implementation of anti-pollution laws, and low waste disposal fees. Reforms in organizations and strategies to resolve such shortcomings are crucial and need full support.

The country is working to resolve the problem. China has led the world in promoting waste recirculation for the past decade by setting goals and enacting strategies, financial initiatives, and legislation. The ultimate aim is to create a "circular economy," in which industrial loops are closed and outputs from one producer are used as inputs by another. This method cuts down on the use of virgin materials and waste production.

The timing is considered to be ideal because of China's rapid urbanization and industrialization. With the aim of fostering Eco industrial growth, the country has invested considerable resources and efforts in developing the CE (Heshmati, 2015). By promoting alternative primary energy options and by reducing waste and maximizing material use, the new CE development plan improves the sense of national security as a whole. Furthermore, beneficial environmental

impacts assist in the enhancement of society's health and general well-being, as well as the development of science, technology, and modernization. Positive effects reach beyond national boundaries and have an impact on global well-being.

Governmental philosophy

The negative effects of economic growth described above have made the Chinese government authorities increasingly aware of the acute contradictions that dominate the traditional model of economic development, recognizing the fact that internal resources are not sufficient to guarantee continuous economic growth and that it was, therefore necessary to find ways and means to mitigate social and environmental problems.

With the beginning of the new century, the concept of the circular economy, (循环 经济, xunhuan jinjj), has made its way more and more within the Chinese legislative context, in line with the efforts of the administration of the general secretary of the Communist Party (CCP) Hu Jintao and Prime Minister Wen Jiabao to rebalance economic objectives with environmental and social ones and attempt to achieve a harmonious and coordinated development (和谐 和 协调 发展, hexie he xietiao fazhan) and the construction of a " prosperous society "(小康 社会, xiaokāng shèhuì), (Weng et al. 2015). In 2000, on the occasion of the Fifth Plenary Session of the XV Central Committee of the CCP, the Chinese leadership, referring to the Confucian idea of harmony, and to the Taoist ideology linked to the supremacy of nature, announced the beginning of a new phase of modernization process that sees at the centre the idea according to which a new " ecological civilization " (生态 文明, shengtai wenming) can remedy the devastating effects caused by industrial society. The notion of a moderately prosperous society, introduced by Deng Xiaoping, was thus strengthened by the introduction of the new concept of shēngtài wénmíng.

The new vision of the government, therefore, rather than being solely oriented towards tangible development objectives, has offered a political-ideological basis for the construction of a legislative and institutional system to improve the protection of the environment and the management of natural resources.

Since 2007, the concept of ecological civilization has been promoted as a long-term goal of the CCP (Geng et al. 2016), guided by a "scientific view of development" (科学 发展 观, kexue fazhan guan). The fundamental idea is that policies - including the environmental ones - must be implemented following a precise hierarchical process and, above all, must be based on exact scientific knowledge that guides the authorities in the practical implementation of the policies and in the achievement of the defined objectives. (Geng et al., 2012).

In 2012, the term ecological civilization was included in the CCP statute, becoming a constituent element of "Xi Jinping's Philosophy" (习近平 思想, xijinping sixiang). Unlike his predecessor, who had considered the environmental crisis as a political and social threat, the new CCP general secretary transforms the concept of shengtai wenming into a key component of the Chinese Dream (中国 梦, zhongguo meng) and of the new era (新 时代, xin shidai) for the rebirth of the Chinese nation, including it in the overall development strategy based on the "five constructions" of economy, politics, culture, society and ecology.

The external driving forces

The modernisation and transition phase, which initiated in the mid-1980s, began to accelerate, and mature in the early 1990s, with average national economic growth rates of 8% and higher. Over the same time period, China's economy opened up to the rest of the world, resulting in

increased foreign exchange, FDI inflows (and, more recently, outflows), and Chinese citizens' international travel.

The recent decades of strict production and environmental standards, international trade legislation, and trends have pushed toward higher labor standards implementation. These are referred to as "green barriers" and they are supposed to reduce developing country competitiveness and export earnings (Heshmati, 2015). Acquiring advanced technology and implementing green production and transportation reforms are needed to meet these requirements. In this respect, Wang and Liu (2007) view CE as a vital component in removing green obstacles and boosting China's national competitive advantage in international trade partnerships.

China's decade-long engagement in global environmental politics, according to the experts consulted, prepared the ground for its proactive effort to advance the sustainable development agenda.

China's involvement in environmental politics extends back to the Stockholm Conference on the Human Environment in 1972, soon after the People's Republic of China assumed the Republic of China's seat on the UN Security Council (Taiwan). Following that, China has attended a number of international environmental conferences and enacted important legislation, including a thorough overhaul of its environmental law in 1989 and 2014. China's ratification of the Kyoto Protocol in 2002, as well as its participation in a series of UN Conferences on Climate Change (COP) meetings, helped to strengthen China's contribution to the global agenda for sustainable growth. China was responsible for more than half of the Clean Development Mechanism projects decided upon under the Kyoto Protocol (CDM). The CDM infrastructure investments raised awareness about the possible co-benefits of proactive participation in global agreement mechanisms.

Chinese rhetoric and policies have been affected in a variety of ways by the United Nations' landmark international conferences, as well as cooperation with multilateral and bilateral collaboration agencies. The specialists consulted from government, think tanks, and NGOs mentioned initiatives and conferences with the United Nations Development Programme, the Economic and Social Commission for Asia and the Pacific, the World Bank, and the Asian Development Bank. Bilateral collaboration with Canada, Germany, South Korea, Japan, and the United States was also discussed, as was the developing discussion among the BRICS countries and South-South Cooperation. The impact of the global development and environmental agenda on policymaking in China is demonstrated by China's participation in global conferences, prompt accession to multilateral treaties and agreements, and the drafting of significant national policy documents and studies in tandem with global summits. Among the latter group of texts, the Agenda 21 White Paper on China's Population, Environment, and Development in the Twenty-First Century, published in 1994 following the Rio Conference on Environment and Development, is particularly prominent. Torney and Yan (2016) indicate that, following the historic climate

agreement reached at the COP 21[5] meeting in Paris, China may become one of several focal points of climate leadership.

China's considerable contributions to accomplishing the Millennium Development Goals (MDGs) — the UN's first series of internationally negotiated goals – created the foundation for China's constructive negotiating position on the Sustainable Development Goals (SDGs) (UNDP, 2015). The "narrative of progress" of China's engagement in accomplishing objectives set upon by the global community aided China's efforts to gain stronger influence in world affairs (Ye & Fues, 2014). China had made significant efforts in the years leading up to the conclusion of Agenda 2030 to resolve key global challenges in its own national policy papers and international talks covering the seventeen sustainable development goals. Its initial concerns about the MDGs and SDGs being combined, as well as the incorporation of good governance goals (Ye & Fues, 2014), have gradually given way to a realistic and versatile approach in international negotiations.

China's favourable involvement with the post-2015 agenda was fuelled by two factors: first, political leaders found it easier to adhere to an aspirational international agenda that aligns economic growth with environmental and social development when national development goals shifted toward a resource-light, low-carbon development model with a high degree of social inclusiveness. Second, China might exploit the Agenda 2030 for Sustainable Development to increase its footprint in the Global South and strengthen its position in global cooperation and politics.

The SDGs' detailed collection of goals and benchmarks, as well as the foreseeable planning, monitoring, and assessment mechanism, are well aligned with China's domestic policymaking style. In Western democracy, the kind of policy concessions struck by ruling parties or coalition administrations differs greatly from China's Five Year Plans (FYPs). These are normally written in far less time and therefore have fewer opportunities for significant contributions from stakeholders outside of the political system. These political agreements are less formal and attract less media attention than China's historic FYPs.

The process of setting the agenda and implementing sustainable development goals involves not only governments, but also businesses and civil society organizations.

Chinese companies attend global and regional business summits that discuss sustainability issues on a regular basis. Many Chinese companies that have signed up for the Global Reporting Initiative (GRI) and the Carbon Disclosure Project were present at the CSR Asia Summits 2016, which took place in Hong Kong (CDP).

China's pursuit of global competitiveness and innovation has aided in the promotion of sustainable development discourses, especially in the areas of energy supply, clean production, and consumption.

[5] The 2015 United Nations Climate Change Conference held in Paris, France, from 30 November to 12 December 2015.

Numerous green policy policies were accompanied by significant investments aimed at reducing energy use and emissions. China has eclipsed the US as the world's largest market for wind and solar energy, and also the world's largest wind turbine producer. The desire to rebalance China's economy, improve energy stability, and fix pollution issues are driving the new policies (Stalley, 2015, p. 205).

NGOs

Development assistance and collaborations with donor agencies and foreign NGOs have supported Chinese NGOs for several years. One of the interview partners, the Chinese Association for NGO Cooperation (CANGO), described how the organization has benefited from international cooperation in the process of amassing expertise on environmental and climate concerns. CANGO has grown from an apex organization to the China International Center for Economic and Technical Exchange (CICETE), a more autonomous nonprofit organization that partnered with likeminded independent Chinese environmental NGOs at international historic conferences such as Rio+20. The global climate policy agenda was highlighted as a motivating element behind the formation of the China Youth Climate Action Network (CYCAN). The organization is now concentrating on mobilizing youth for climate action, collaborating with the green private sector, and tracking the outcomes of global climate summits, especially the COP meetings.

In the light of China's economic growth and middle-income status, the amount of development assistance to China has steadily decreased over the last decade. However, policy debate, international networking, and exchange activities have persisted, and the amount of research projects, research institutes, and non-profit organizations in China working on sustainable development issues has grown. The majority of "green sector" NGOs reported increased dialogue and cooperation with government agencies and the private sector. (Kuhn, 2016)

The concept of the CE

The internal and external drivers mentioned in the first half of the chapter resulted in the development of a CE concept with roots in cleaner production, industrial ecology, and ecological modernization thinking, as well as examples of implementation in Europe, the United States, and Japan.

McDowall states that the CE can be seen as a manifestation of ecological modernization, the concept that declares that tensions between the environment and the economy can be resolved by technological and social innovation (McDowal et al., 2017).

Nevertheless, evidence on the circular economy's adoption in China indicates that a broader consensus has been established on the CE notion, which is similar to industrial ecology in numerous ways. This notion emphasizes the benefits of reusing and recycling residual waste items. It involves energy, water, multiple by-products, and expertise (Yuan et al., 2008). The most common example of this concept would be the industrial symbiosis. The term "industrial symbiosis" refers to a concept in which the benefits are derived from both economic and environmental factors. Economically, agglomeration of companies brings together pools of common production factors such as labor, capital, and energy, which can lower factor prices and

increase productivity (Anderson, 1994). Aside from the transportation and transaction costs saved by proximity, businesses that locate together can more readily receive technological spillover. On the other hand, environmental benefits can be achieved not only by reducing the volume of waste discharged, but also by reducing the use of virgin materials in economic activities (Anderson, 1994).

One of the pioneers who first introduced the idea of circular economy to China, Zhu (2005), proposed that it is, in essence, an ecological economy that would bring profound changes to the conventional system of development. This model must take into account three aspects: economic, social, and environmental dimensions. In terms of the economy, it improves regional and domestic competitiveness by increasing the efficiency of resource distribution, resource utilization, and productivity. In terms of the environment, it eliminates negative externalities primarily by redesigning the industrial system in an environmentally friendly manner. Socially, it addresses unemployment issues, equalizes economic growth distribution, and increases people's general well-being on a social level.

Because the flow of materials and energy penetrates both fields of production and consumption, the 3R principles (Reduce, Reuse, and Recycle) have been ingrained as the core for guidance (Zhu and Qiu, 2007). Reducing refers to lowering the amount of raw energy and materials used during processing by increasing the efficiency in production. Reusing refers to the process of repurposing a company's by-products and wastes as resources for other companies or industries. It also applies to using products to their full potential while maintaining and repurposing them on a regular basis to extend their lifespan. To avoid wasting potentially useful resources, recycling promotes the conversion of recyclable materials into new goods. As components of the whole process, these concepts hold varying degrees of significance, with resource use reduction being the most important within a circular economy framework (Su et al., 2013).

Early initiative on 3R principles, only recently shift from clean up approach to a more holistic way of tackling environmental and social externalities (Ellen McArthur Foundation, 2020).

China's 11th Five-year Plan for Economic and Social Development describes CE as combining economic development with resource conservation in accordance with the principle of 3R. It proposes a closed loop of resource development, production, consumption, waste generation, and recycling. The CE Promotion Law further emphasizes CE as "a general term covering activities that reduce, reuse, and recycle materials in production, distribution, and consumption processes".

All in all, the 3R principles are set to guide the reduction of the negative effects of economic activity on the environment over the course of a product's entire life cycle.

China's socialist market economic system

China's economic system is that of a socialist market economy (社会主义市场经济 shehui zhuyi shichangjingji), as defined by Chinese officials: the state continues to exert influence over the country's economic development, even if the free market is now widely acknowledged.

In the relationship between the government and the market, the government is in a dominant position. This is the essential pattern in the socialist market economy's connection between the government and the market. From the perspective of practical effects, the current Chinese government and market are moving towards a "strong government and strong market" (强政府和强市场 qiang zhengfu he qiang shichang) (Liu H., 2016).

The centralization of authority across a wide range of domestic politics has been a characteristic of the leadership under Xi Jinping, General Secretary of the Chinese Communist Party since 2012.

The stringent top-down approach adopted by Xi Jinping under the banner of "top-level design" helps remedy prior distortions produced by uneven policy execution and resource allocation, but it also runs the risk of suffocating innovation and reducing effective governance. In 2012, the CCP's Central Compilation and Translation Office documented 50 instances of "policy innovation," but only a few in 2015, fewer than half as many as in 2012, the Hu Jintao-Wen Jiabao administration's final year.

Local Chinese Communist Party and public officials have long been part of a larger power structure, which is overseen by a rigid cadre system. Local governments have never been completely self-contained. Local cadres, on the other hand, have a great deal of discretion. This enables them to disrupt or derail policy, as well as participate in corruption and other predatory activity. The same discretion, on the other hand, is the bedrock of China's amazingly adaptable political framework and the bedrock of effective policy implementation.

However, China's notoriously fragmented and overlapping environmental governance structure is yet another key impediment to efficient local implementation of environmental legislation in the country. Fragmented environmental bureaucracies have primarily resulted in apparent interdepartmental coordination difficulties in the field of environmental protection. As Kostka (p. 22) expressed:

"*The implementation and enforcement of environmental mandates at the local level is partly hindered by the fragmented and ambiguous allocation of environmental responsibilities. Usually, numerous government agencies are responsible for the implementation of a single environmental issue but sometimes without a clear division of labor, which in practice ultimately leads to a lack of accountability (Ran, 2013). For example, more than five departments have a role to play in energy efficiency implementation at subnational levels: the local Development and Reform Commission (DRC), the Economic Commission, the Construction Department, the Transportation Department, and the Environmental Protection Bureau (EPB).*"

Five-Year Plans

The process of modernization of the law started after Mao's death has been characterized since its beginnings by a profound interaction with foreign legal systems and by a massive import of techniques and languages typical of the western legal tradition (Cavalieri, R., 2015). In part, this import was a spontaneous result of the need to give modern rules to the "socialist market", in part it was the result of an adaptation of domestic law to global standards imposed on the PRC by foreign trade pressures and the ratification of hundreds of international agreements. The fact is that Chinese law has conformed, in its forms and contents, to the dominant legal models, losing much of its traditional originality.

However, it was a selective import. The rules prevailing in the most industrialized countries and in multilateral fora have been introduced into the internal legal system through a sophisticated work of adaptation to national socio-economic characteristics. On one hand, much freedom and autonomy typical of liberal societies have been recognized. These include the right to undertake economic activities and the renewal of civil and commercial law. On the other hand, many other freedoms were denied. In particular, association in independent trade unions is prohibited and the dogmas of the unity of state powers and the supremacy of the communist party cannot be questioned.

In this way, the Chinese leadership has been able to find a balance between the choice of adapting the regulatory system to global standards and the need to implement their own political strategies, creating an original legal system, in which the law plays an instrumental function. In this system, the legislator and the judge have the task of executing or formalizing the political will of the Communist Party and there is no body to control the constitutionality of the laws.

The party is in charge of laying the foundations and principles of Chinese communism, as well as developing economic development strategies, setting growth targets, and implementing changes.

Since 1953, the Five-Year Plan (FYP) has been the primary tool used by the government to determine economic and social issues on a national and local level.

Planning is a crucial feature of supposedly socialist economies, and one national plan usually includes specific economic development instructions for all of the country's regions. The plans Since the 11th Five-Year Plan, which ran from 2006 to 2010, China's plans have been referred to as "guidelines" (规划 guihuà) rather than "plans" (计划 jihuà) to better reflect the country's shift from a Soviet-style command economy to a socialist market economy.

The administration approved the Soviet economic model, which was centred on state ownership in of the modern sector, vast collective agricultural units, and centrally controlled economic planning, when the governance led by Mao Zedong and Zhou Enlai was willing to rely on an unparalleled-scaled program of industrialization and socialization after rebuilding a stable productive base. The First Five-Year Plan (1953–1957) embodied this approach to economic development and it still maintains this Soviet-style economic blueprint approach, as more recently seen in the latest 14th FYP.

The updatad list of FYPS is as follows:

1. The First Five-Year Plan - 1953-1957
2. The Second Five-Year Plan - 1958-1962
3. The Three Five-Year Plan - 1966-1970
4. The Fourth Five-Year Plan - 1971-1975
5. The Fifth Five-Year Plan - 1976-1980
6. The Sixth Five-Year Plan - 1981-1985
7. The Seventh Five-Year Plan - 1986-1990
8. The Eighth Five-Year Plan - 1991-1995
9. The Ninth Five-Year Plan - 1996-2000
10. The Tenth Five-Year Plan - 2001-2005
11. The Eleventh Five-Year Plan - 2006-2010
12. The Twelfth Five-Year Plan - 2011-2015
13. The 13th Five-Year Plan - 2016-2020
14. The 14th Five-Year Plan - 2021-2025

The legislative process

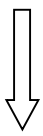
in China, the decision-making process inherent to the circular economy follows a hierarchical approach that sees the National People's Congress at the top. The latter holds the legislative role and therefore has the task of enacting the laws relating to the circular economy while the State Council, the branch directly dependent on it, promotes the circular economy as a development strategy through general regulations to then issue more detailed policies.

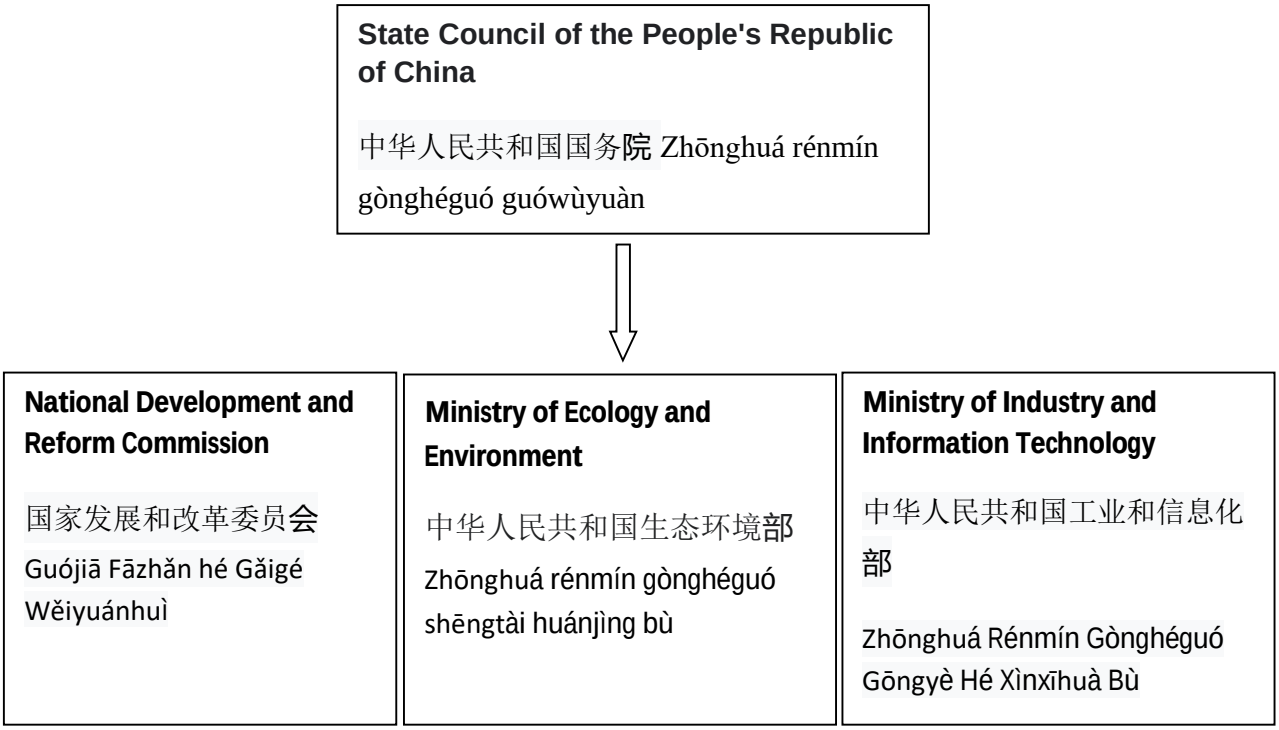
Within the State Council, three government agencies lead the promotion of the circular economy: the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIIT) and the Ministry of Ecology and the Environment (MEE).

The Ministry of Ecology and the Environment, formerly known as the Ministry of Environmental Protection (MEP) and, before 2008, as the State Environmental Protection Admnistration (SEPA), plays a leading role, concurrently with the National Development and Reform Commission, in the promotion of the circular economy both through the support provided to studies and researches conducted in the academic field, and through the launch of demonstration projects of clean production, eco-industrial parks and recycling-oriented cities. The Ministry of Industry and Technological Information, on the other hand, manages the implementation of resource-oriented policies and, more recently, the regulation of extended producer responsibility.

National People's Congress of the People's Republic of China

中华人民共和国全国人民代表大会 Zhōnghuá Rénmín Gònghéguó Quánguó Rénmín Dàibiǎo Dàhuì





It should be noticed that the hierarchical process also extends to the territorial level: while at the national level the policies and programs are established by the agencies described above, at the lower levels the implementation of the policies is entrusted to their counterparts.

The features of Chinese CE policies

Focal points

In China, the CE has been adopted as a progressive growth model to help China leapfrog towards a more sustainable economy system, rather than being seen as an incrementally upgraded environment management strategy (Geng and Doberstein, 2010).

In Chinese policy papers, the CE is used to address the problem that rapid industrialization and development has resulted in serious environmental harm, and that China needs a new paradigm to balance continued growth with broader environmental concerns. The main CE policy documents assume that economic growth will continue, meaning that the issue is aligning continued growth with environmental and social issues, not stimulating economic development. The following quote exemplifies this point.

"Since the eighties of last century, China's rapid economic growth has resulted in great achievements, but has also used a lot of resources and created environmental costs. Economic development and resource and environmental issues have become increasingly acute contradictions .... Therefore, itis necessary to change the economic growth model . . ." (National People's Congress, 2008)

This is due to the CE concept's strong association with Hu Jintao's administration's efforts to articulate a policy rebalancing initiative that takes into account environmental, social, and economic goals, a mission dubbed "harmonious growth." (Weng et al. 2015).

In China's economy, production and exports are far more significant, with ramifications for industrial activity and pollution. In this perspective, China's CE policy's emphasis on pollution and cleaner output should come as no surprise.

Pollution

The CE in China is more strongly associated with pollution and the broader concept of sustainable development (and to ecological civilization) (Weng et al. 2015). Pollution issues play a prominent role in the Chinese viewpoint, as does the need to create a "resource-saving and environmentally sustainable society" (State Council 2005) and ecological civilization (State Council 2013). According to McDowall et al. (2017), pollution is mentioned in Chinese policy documents much more frequently than it is in European policy documents. Both sets of records play a key role in terms of waste and money. In European texts, the word "innovation" is often used, although it appears only infrequently in Chinese documents.

Waste

An assessment of policy documents reveals that Chinese CE policies are concerned with waste and resources.

Chinese CE guidelines include a strong emphasis on municipal waste, industrial waste, and wastewater, and also energy. Despite the fact that China's CE is explicitly framed as focusing on the principles of minimize, reuse, and recycle, with a focus on reduction, China's plans and policies

put less emphasis on initiatives to influence consumption patterns. Rather, there is a stronger emphasis on comprehensive coverage of individual industrial industries and interventions to improve manufacturing productivity and minimize waste and emissions. This illustrates the above-mentioned variations in framing, in that Chinese CE policy is more concerned with industrial pollution. (McDowall et al., 2017)

The CE's major focus has increasingly changed away from narrow waste recycling and toward broad efficiency-oriented control during closed-loop flow of material at all phases of the manufacturing, distribution, and consuming process. In addition to resource and waste challenges, the project's scope has been expanded to cover energy efficiency and conservation, land management and soil management, and integrated water resource management issues (Su et al., 2013).

Scale and Place

Scale and geography play an important role in China's model in two ways.

First, as stated in articles 29 and 37 of the CE Promotion Law, China's CE policy emphasizes a commitment to incorporate CE concepts into land-use planning. The ongoing rural-urban transformation in China is one reason for this: land-use planners are facing new challenges as new urban and industrial areas emerge. These issues are reflected in CE policy, which focuses on environmentally sensitive spatial integration of residential, agricultural, and industrial activities. This is in stark contrast to the situation in Europe, where urbanization is not happening at the same pace.

Second, China's CE policies stand apart by designating and funding CE pilots or demonstrations in specific provinces, towns, or zones (such as industrial parks) (Zhang et al. 2010). This technique works in a variety of settings, from large cities to tiny firms (more than 100 businesses have been designated as CE demonstration enterprises) (Geng et al. 2012). Municipal or industrial park authorities (or, in the case of enterprises, corporate management) can apply to the National Development and Reform Commission (NDRC) for a classification, which is subsequently reviewed against key performance measures. The NDRC awards grants to specified entities, and applying for one can be an important aspect of a community's economic plan. The average subsidy per CE park designated in 2012, according to Thieriot and Sawyer (2015), was about 182 million renminbi (RMB). In China, regional pilot zones are a popular governance tool (Heilmann, 2008). Both the federal and provincial governments employ these designations, which result in a wide range of special zones, anmely low-carbon zones, eco-industrial zones, circular economy zones, and so forth), with some places obtaining several categorizations. Theoretically, the lessons learned in designated experimental zones are then used to guide future policymaking (for example, the 2013 State Council refers to the lessons learnt from 60 CE pilots). This method has been defined by Heilmann as "experimentation under hierarchy," and he has shown how it is part of a larger focus on experimentation and gradualism in Chinese governance (Heilmann, 2008).

Zhao et al. (2016) have emphasized the worldwide unique nature of this governance model in terms of low-carbon growth, claiming that China's usage of experimental zones is partially a

response to the nation's well-known environmental policy implementation discrepancies. Environmental policies in China have often been subordinated to local economic imperatives, resulting in a significant implementation gap (Zheng 2011). The lack of clarity in many of China's environmental legislation, as well as the tax structure that permits local governments to rely on local development to augment budgets (Shen, 2011), exacerbate that same implementation gap (Wang and Wang, 2011).

Zone designations by the federal government (and the funds associated with them) will help to bridge the implementation gap by providing direct incentives to achieve CE targets. Because such classifications represent just a small percentage of economic activity, their significance is restricted (Thieriot and Sawyer 2015). Upscaling projects undertaken in authorized parks, on the other hand, make for a considerable share of Chinese manufacturing production (approximately 50 percent) (Mathews and Tan 2016). Indeed, both cities (Su et al. 2013) and industrial parks (Yu et al. 2015) have shown progress in relevant performance metrics, but these studies also indicate that implementation problems remain.

In Europe's structure, there are parallels to China's experimental governance. Under the European model, major Member States are experimenting with innovative policies, which means that the European Semester (a process that analyzes various experiences and policies throughout Europe to facilitate policy learning) and the Cohesion policy, which finances the development of the less advanced regions, facilitating in this way the dissemination of policies to less developed regions, are critical. The European Union's Horizon 2020 budget also contains funds for "large-scale demonstrations," but these are much smaller in scale than China's experimental CE zones. In short, China's approach to CE exploration at various scales incorporates a more systematic approach. (McDowall et al., 2017).

Implementation Approaches

To encourage the emergence of eco-industrial ventures, countries appear to require both a top-down and bottom-up strategyInstitutional frameworks like as the Circular Economy Promotion Act's legislative requirements, and also the Circular Economy Pilot Demonstration Program or the Eco-Industrial Park Program developed by different government entities, appear to ensure the former.

China is rapidly nearing the cutting edge in a variety of fields, thanks to a tremendous burst of innovation. However, this is taking place in the context of both massive top-down government initiatives and a market made up of fast-moving private enterprises of various sizes exploring new boundaries.

However, as Mathiews et al. propose, a bottom-up strategy is arguably more crucial (2011). Mathiews et al, taking the arguments by Desrochers (2002), indicate that the concept of "modern ecology" is at least as old as industrialism, if not older, if we include closed-cycle traditions of Asian village life in medieval times. Desrochers demonstrates with several examples that closing the loop was seen as a good business opportunity in every aspect of industrial production, and he opens up a new field of inquiry by asking why such practices have been so "alien" to modern

industry, where the linear paradigm of "raw materials in" at one end and "wastes out" at the other is dominant. According to the researcher, market-driven initiatives to alleviate environmental harm, such as the formation of closed loops among businesses, can result in both more ecologically friendly behaviours and increased profitability.

With changing market dynamics triggered by factors such as higher energy and resource prices and market entry deregulation, we expect a widespread bottom-up approach, with more and more individual players taking eco-industrial initiatives and adopting the circular economy concept, once those ideas make financial sense for them (Matthews & Tan, 2011).

However, China currently has a plethora of these eco-industrial projects, both those mandated by government agencies and those born out of private initiatives between businesses. For example, we can see many enterprise and cluster-level initiatives being explored in eco-industrial parks, like in Guigang, as well as local and state government efforts at the EIP level (Mathews et al., 2011). As a result, we can see a combination of state-level and institutional administrative organs directing investment into newfound channels, along with prominent entrepreneurial efforts in different industries. The massive entry of non-state companies into new industries as a result of the reform has resulted in a Schumpeterian style of competition, which has contributed significantly to the Chinese economy's prosperity.

We foresee a similar model to evolve for the circular economy's establishment, with profit-driven enterprises taking increased responsibility and initiative in the process (Mathews et al., 2011).

Levels of implementation

Chinese metrics are cross-scale, representing China's multilevel approach to CE implementation.

There is widespread consensus that successful circular economy implementation necessitates activities at three scale levels: micro, meso, and macro (Geng and Doberstein, 2010). In a perfect scenario, the CE strategy will be applied simultaneously at all three stages of aggregation: micro, meso, and macro (Heshmati, 2015).

Ongoing CE operations are classified into four categories by Su et al. (2013): production, consumption, waste management, and other support. Because the complexity of the activities rises as the scale level increases, practices at the micro and meso levels resonate more than those at the macro level.

Table 1 Practices of CE in China Data Source: Heshmati, 2015; Su et al., 2013.

	MICRO	MESO	MACRO
PRODUCTION	Cleaner production Eco-design	Eco–industrial park	Network of eco-industrial parks
CONSUMPTION	Green consumption	Eco-living Park	Renting services
WASTE MANAGEMENT	Product recycle system	Waste trade market	Regional circular industry
OTHER SUPPORT	Policies and laws; NGOs	Policies and laws; NGOs	Policies and laws; NGOs

Heshmati (2015) defines each combination of these levels and areas, based on Su et al (2013) 's categorization. At the lowest level of aggregation and operation, meaning the manufacturing of enterprises and agricultural products, producers are encouraged and required to use cleaner production processes and eco-designs. Clean production entails low emissions, while eco-design entails integrating environmental concerns into manufacturing processes, models, and products that are reliable and sustainable thanks to innovative ideas and production lines. China's Cleaner Production Promotion Law was implemented in 2003. The legislation tackles key concerns such as emissions output and resource efficiency at all levels of the manufacturing process. Highly polluting enterprises must take steps to reduce their energy intensity, material consumption, and negative externalities (Hicks and Dietmar, 2007 In the consumption and waste management fields, green consumption and the use of environmentally friendly resources and goods are encouraged, and generated wastes must be recycled into new production stages as part of an industrial eco-system (Geng and Duberstein, 2008).

CE activities at the intermediate meso scale include the establishment of eco-industrial parks and eco-agricultural systems. Other steps, such as environmentally sustainable industrial park designs and waste management, must be supplemented with these. Development of waste trade networks and venous industrial parks for material recovery from green products are two additional projects (Geng et al., 2010). Using the notion of industrial symbiosis, eco-industrial parks make advantage of shared infrastructure and services.This helps clusters of companies to work together to control resource flows and exchange industrial by-products, reducing environmental externalities and the nation's dependence on resources. The increased efficiency and competitiveness of the industry was boosted by the lower overall production costs. The eco-agricultural method achieves a similar result (Liu et al., 2012). Green design for residential neighbourhoods is part of the initiative, which seeks to create an environmentally sustainable living environment. The focus is yet again on regulating and managing urban energy, water, and land usage to reduce their misuse, as well as managing and recycling waste water and solid waste to improve quality of life and public health (Zhu, 2005).

Finally, at a macro level, CE practice necessitates the formation of complex and comprehensive cooperative networks as well as active cooperation between industries and industrial parks, including main, secondary, and tertiary sectors in manufacturing areas as well as the residential sector. The macro level in China is concerned with major cities or regions/provinces. The goals of the 3R principles can be achieved through careful planning and management of urban infrastructure, suburban industrial production, and agricultural layouts, as well as innovative public policies that phase out energy-intensive and polluting technologies and activities and replace them with environmentally sustainable technologies and activities (Geng et al., 2010).

The last area of other support includes initiatives from governmental and nongovernmental organizations that encompass all aspects of production, use, and waste management at all phases of aggregation.

On the one hand, China's environment and CE implementation are primarily regulated by two agencies: the Ministry of Environmental Protection (MEP) and the National Development and Reform Commission (NDRC). The first is responsible for the National Pilot Eco-Industrial Park Program, which focuses on the meso level, whereas the latter is responsible for the National Pilot Circular Economy Program, which addresses both the micro and macro levels (Zhang et al., 2010).

The growth of environmental and non-governmental organizations, on the other hand, reinforces legislation and activities aimed at changing public perceptions toward the environment. As stated by Xie (2011), investing in education, disseminating knowledge, and encouraging active public involvement help to raise environmental awareness. NGOs with easy access to the grassroots have an important, if not yet realized, impact on the promotion of CE in society. Although no clear studies have looked into the relationship between CE and eNGOs in China, the country's eNGOs are rapidly increasing. The overall number of eNGOs grew from 2,768 in 2005 to 3,539 in 2008, and they have a strong relationship with the global environmental movement (Xie, 2011).

Policy instruments

On one hand, the CE policy initiatives, like many other environmental and energy-saving policies in China, use a variety of policy instruments, such as mandates, incentives, voluntary measures, information programs, and education. On the other hand, CE policies have frequently featured both compulsory and incentive-based instruments, contrary to environmental policies, which have traditionally concentrated mainly on compulsory instruments. The majority of the steps are simple demands on business behaviour — adopting specific technologies, reusing certain waste, and so on — while the rest are instructions for materials and energy efficiency in industrial processes (Zhu et al., 2018).

Incentive programs use a wide range of instruments, the most common of which are tax relief and direct subsidies. Emissions charges, funding plans, rewards, and pricing schemes are some of the other tools available. Although incentive-based instruments have been used for a long time, subsidies, funding, and pricing structures have become more common over time, suggesting a preference for indirect market intervention over direct market intervention.

Demonstration programs have been implemented at all levels of government. The government promotes positive awareness about CE and provides political incentives for other places to pursue similar socioeconomic development policies by acknowledging regions, counties, and local jurisdictions where a CE has been well established through national nominations (Zhu et al, 2018).

Target and responsibility

Via target responsibility structures, targets play a key role in China's governance system (Liu et al. 2012). According to this scheme officials at subsidiary levels of government are promoted based on their success against targets resulting from the Five-Year Plan. Against this background, central government regulations may be applied less by the letter of the law and more by benchmarking against indicators. In this respect, China's Circular Economy Promotion Law mandates the creation

of target responsibility structures to promote the CE, as well as the utilization of advancement toward indicators in state officials' performance assessments. This is one of the goals of the 11th and 12th five-year plans, incorporating the energy and water intensity of GDP, the output and reuse of industrial solid waste, the reuse of industrial water, the efficiency of irrigation and the recovery rates of recyclable materials. Many of these metrics, however, should not be viewed exclusively through the prism of CE, as they are often linked to other policy initiatives, some of which predate the CE's emergence as a policy issue.

China has a complex system of indicators, with various indicator sets for micro (firm level), meso (eco-industrial park), and macro (national level) (city or province). These are an integral part of the regional experimentation strategy using pilot zones. An application for designated status is submitted by industrial parks and cities based on an implementation plan that describes expected progress toward key indicators. As a result, the indicators are optional in the sense that only entities pursuing designated status must monitor and report on them. It is, however, critical to have a consistent set of national indicators with which to identify, compare, and monitor the efficiency of these numerous pilots for a successful implementation—and such indicators must be appropriate for the different scales of the initiatives, hence China's multilayer structure.

These multilevel metrics have been extensively analysed and discussed (Zhang et al. 2010). The indicators have been criticized for, among other things, their lack of social indicators, absolute carbon reduction indicators, absolute material/energy reduction indicators, and prevention-oriented indicators (Geng et al. 2010). Furthermore, data collection, estimation, and submission do not have a clear definition or a structured method. Finally, the NDRC only offers broad lists of metrics that should be published, rather than concrete targets and values to serve as benchmarks (Geng et al. 2010).

In order to offer a clearer national framework for informing ongoing policy, the National Bureau of Statistics (NBS) has produced a single composite indicator of China's progress toward a circular economy. In this assessment are included m ultiple indicators of similar relevance to european sets of comparable features that attempt to present an overall view of political significance but just don't play a prominent role in governance.

Ma and Ortolano (2000) address how the Chinese metrics can be used to achieve environmental policy objectives through informal rather than formal institutional frameworks. Local businesses saw reaching government indicators and winning environmental awards as a way to gain face, according to a series of case studies. Similarly, officials and businesses can perceive weak performance against formal indicators as a loss of face, and therefore make efforts to reach them even though no formal incentives are in place.

To summarize, substantial progress on these metrics, even though critical, is still lacking. We will, now, report on the main measurement indicator for the CE, keeping in mind that theory and practice are in contrast with each other.

Measurement Indicators

Raimund Bleischwitz, University College London scholar, when asked about China's circular economy's successes during a Disruptive Innovation Festival webinar in 2018, answered:

"China is impressive and successful when it comes to CE being promoted through industrial parks and its impressive detail for indicators that Europe does not yet have." (EMF, 2018).

To evaluate the effective development and implementation of CE, a set of indicators is needed. The indicators are intended to serve as metric measures of CE's progress and results, guiding decision-makers in the further development and evaluation of various policy instruments. Environmental and other government agencies, as well as academics from various countries, have worked to establish and encourage a common collection of indicators. In practice, however, the diversities within companies, industries, and regions have required the creation of several sets of evaluation metrics at the same time.

Reforms have occurred at numerous levels of aggregation, including micro, meso, and macro, as well as across many operational sectors, such as manufacturing, consumption, waste management, and policy, as previously documented. The set of indicators would also have to take into account heterogeneity across multiple dimensions.

At the enterprise level, indicators are adapted to the features of individual enterprises or industries. Two government agencies, the NDRC and SEPA, have released two separate indicator evaluation schemes at the Eco-Industrial Park (EIP) level. The former focuses solely on the implementation of the 3R principles, whereas the latter also evaluates the influence of EIP on economic, environmental, and social factors. At a regional level, the indicator systems are often based on CE's ultimate goals and on the 3R principles, where scholars' research are most abundant (Su et al., 2013), however a few academics have also created indicator systems based on the ecological efficiency theory (Su et al., 2013).

In order to deal with the problems related to these measurement indicators that were previously mentioned, the Chinese government created an experimental Circular Economy Evaluation Indicators System in 2007 to ensure that local officials and corporate leaders are held accountable. The system comprises two levels of indicators: those at the industrial park level and a second set of indicators at a more macro level. Resource production indicators (volume of GDP created per unit of resource used), resource consumption indicators (resource consumption per unit output of products or GDP), resource usage indicators, and waste emission indicators were found for each level. On this line, the 13th FYP further highlighted the intention of creating a baseline for environmental concerns and expanding central and local governments' access to real-time, online data for better monitoring, evaluation, and enforcement.

Calculating the weight of each sub-indicator prior to consolidation is another problem with CE evaluation and indicator systems. Average weighting, which assigns the same weight to each indicator, is one of the most commonly used strategies. The analytical hierarchy technique breaks down complex problems into their constituent pieces, which are then organized into multiple

levels to build a multi-level structure. Principal component analysis (PCA) as a technique for identifying patterns in high-dimensional data and expressing them in a lower dimension to highlight their similarities and contrasts; PCA as a technique for identifying patterns in high-dimensional data and expressing them in a lower dimension to highlight their similarities and contrasts; PCA as a means for identifying patterns in a high-dimensional structure; appraisal of fuzzy synthesis and grey correlation degree technique which both have the advantage of avoiding subjective judgment by personnel; and the full permutation polygon synthetic indicator technique.

Micro-level

According to Geng et al. (2012), a key flaw in all indicator systems is the way individual indicators are aggregated into a single dimension or index. In their critical analysis of the Chinese indicator system, they provide a comprehensive review of these indicators' across-dimensional characteristics.

Each firm must develop firm-specific indicators based on its characteristics, condition, existing difficulties, and other factors at the basic micro-level. As a result, a unified and single set of metrics may fall short of capturing the whole progress of circular economy in many organizations.

Rather of focusing on a single company, some researchers measured the performance of an entire industry (Du and Cheng, 2009). The indicator system appears to be broader in scope, with a focus on overall performance. For example, Du and Cheng (2009) calculated the economic efficiency of 47 iron and steel businesses observed from 2003 to 2006 using a Date Envelopment Analysis model with 9 input-output indicators and the Malmquist productivity index as an alternate technique. Others focused on the implementation of CP in China (Shi et al., 2008). Shi et al. (2008) devised a set of twenty metrics to determine the barriers to a CP uptake, where policy and market, financial and economic, technical and information, and management and organizational barriers are all taken into account.

Meso-level

Two sets of interim EIP assessment indicator systems have been developed by Chinese government agencies NDRC and SEPA to ensure objective and trustworthy information on the state of EIP in China at the intermediate meso-level. The NDRC designed a four-dimensional indicator system that includes resource output rate, resource consumption rate, integrated resource utilization, and waste discharge reduction rate. The quantity of production value in EIP generated from one unit of material, land, energy, and water usage is referred to as resource output rate. The higher the ratio indicates the higher efficiency of resources. Indicators indicate the energy and water concentration in the second component of the EIP, resource consumption rate, and provide an alternative approach to assess resource efficiency. The resource comprehensive utilization rate is used to look at how much industrial water is reused and how much industrial waste is recycled. The last dimension looks at how to reduce industrial waste disposal. From those dimensions, it's evident that this system is based on the 3R principles, which aim to increase resource and energy efficiency while also reducing, reusing, and recycling industrial waste.

A different story can be told in regards with the SEPA's structure of indicators. Despite the fact that the number of dimensions in both sets of indicator systems is the same, that is not the case for the concerns in interest. SEPA merged the four components of the NDRC's indicator system into one, material reduction and recycling, and attached three more: economic growth, control of pollution, and management and administration. When we consider the unique characteristics of China's EIP, the design of SEPA's dimensions appears to be better suited. This is because China's industrial parks serve a dual purpose, incorporating both production and residential areas (Geng and Cote, 2002). As a consequence, the growth of EIP is inextricably tied to the behaviors, perceptions, and economic health of citizens.

Another distinction between SEPA's indicators and those created by NDRC is that SEPA divided industrial parks into three groups based on their features, namely sector-integrated, venous, and sector-specific industrial parks, and then designed three sets of indicators for each type (Geng et al., 2008). Generally speaking, indicators for those three forms of EIP are almost the same, except for a few differences in the second group of indicators, waste reduction and recycling, which are more detailed in venous parks.

Macro-level

The macro-level is probably the level that has been studied the most intensively in terms of forming indicator system and evaluating CE's performance by the scholars.

Except for the addition of one more dimension, no major changes have been made to the indicator system designed by NDRC from the one for the intermediate meso-level. The need of regional recycling has been stressed more and more, particularly for commodities such as iron scrap, nonferrous metal, wastepaper, glass, plastic, and rubber. It is obvious that China's political commitment of promoting circular economy is heavily based on resource efficiency.

Scholars, on the other hand, have proposed that, in addition to indicators evaluating 3R principles or environmental characteristics, a more systematic evaluation system be constructed by including indicators of economic development and social factors (Geng et al., 2008). Among the measures included the most notable are: the state of the economy, with data referring to the GDP per capita and economic growth (Geng et al., 2008); the economy's potential, such as export share, technology development, and capital investment (Chen et al., 2009); and structure of the economy (Geng et al., 2008). In terms of social factors, the most popular variables included were unemployment rate, conditions of the living areas and disposable income (Geng et al., 2008).

While the majority of scientists created indicators based on the 3R principles and CE goals, others (Zhu, 2007) maintained that the development of CE was, in and of itself, an improvement in eco-efficiency, defined as the ratio of GDP to natural resource use. Zhu's eco-efficiency metrics for Shanghai comprised land, water, energy, and raw materials productivity, as well as sulphur dioxide, wastewater, and solid waste productivity. He then merged them with the IPAT3 tool to evaluate and anticipate future scenarios of energy use and pollution production.

Chinese CE policies in categories

China has a long tradition of resource-oriented policies and introduced production-oriented policies rapidly after the year 2000, according to a comprehensive study of 280 related regulations by Zhu et al. (2018). Four main categories of policies and related examples have been determined based on their primary purposes: resource-oriented, production-oriented, waste, and use-oriented and life cycle policies. (Zhu et, 2018).

Resource-Oriented Policies

The policies involving comprehensive use of resources (CUR) have the longest history among the Chinese CE policies, having been introduced in the early 1950s (Zhu et al., 2018). The idea of CUR, like many other Chinese institutional and policy arrangements at the time, was derived from the Soviet Union (Zhu et al. 2018). The initial concept was simply to get more goods out of the same resource, which is thought to have originated domestically in the mid-Ming Dynasty's "mulberry fish pond" business model in the sixteenth century. This model has similarities with the concept of industrial symbiosis (Chertow 2007), and it intends for mulberry bushes, silkworm farms, fish farms, and silk manufacture to be all grown on the same plot of land, and for the by-products to be shared.

The CUR's debut was set against the backdrop of China's aim for rapid modernization and limited resource availability. Being first introduced for the efficient utilization of water resources through the construction of hydrology projects, then for by-products from mining and the production of coal and other fossil fuels, and, finally, in the late 1950s, it was adopted for valuables from industrial smelting (Xu, 2014). Separate policies and directives governing the utilization of industrial solid waste, wastewater, and waste gas were also in force during this period (Palmer, 1998).

While industrial pollution-related health issues were listed as a concern in policymaking (Xu, 2014), they were not of primary consideration. The fundamental goal was, and continues to be, to produce more things from the same resources by increasing resource flows and decreasing waste flows. As a result, this policy prototype's primary focus is on the resource extraction stage and CE flows.

Extending policy-driven recycling and reuse opportunities, as well as more institutionalized incentives, are all part of the implementation of resource-focused policies. Initiatives began to contain a list of wastes that qualified for policy benefits in the late 1970s and early 1980s, with more waste types being added to the list.
In 1986, a catalogue listed over 100 different forms of waste reuse opportunities. 12 Those wastes' meanings became more precise as well.
In 1996, further substantial progress was made as a result of the passage of many policies. They expanded the number of waste recommended for reuse to over 200 and defined them, with industrial waste making up the majority. Furthermore, what once were rather complex waste user advantages, were now reduced to two types; value-added tax relief; and corporate income tax relief.

In subsequent revisions of resource-oriented strategies, the two forms of tax relief have remained the key rewards. In the early 2000s, the number of wastes mentioned decreased, especially for industrial waste, owing to several concepts in previous catalogs being too specific and therefore having to be changed.
Due to wider coverage and more refined meanings, the number of wastes increased significantly in all five categories in the late 2000s. Opportunities for the reutilization of wastes, such as food residues, bioenergy, used watercraft, and aluminum cans have recently been added to the policy catalogs. Between 2011 and 2015, the number of industrial wastes in the category saw a considerable decline. However, the opposite happened for old consumer products, utilities, and other wastes, which saw a slight rise, resulting in a small increase in the final number of wastes reported.
Scrap solar panel pieces, as well as building and demolition waste, are examples of newly added waste. The transition reflects China's socioeconomic growth, especially urbanization and a consumerist lifestyle. During this time, the NDRC supported two forms of pilot projects: urban mining and resource utilization from food residues.

Production-Oriented Policies

Cleaner development is another policy priority that is closely related to the CE. Cleaner output entails reducing emissions and increasing productivity by preventing pollution at the source—production processes—through improvements in technology, management, and operating systems. In the 1970s, the concept came from 3M's "Pollution Prevention Pays" scheme in the United States (Zhu et al, 2018) and later, cleaner development in Europe (Geiser 2002). The United Nations Environment Program (UNEP) and the United Nations Industrial Development Organization (UNIDO), on the other hand, had a stronger and more notable impact on China in the 1990s, having an influence in the Cleaner Production Promotion Law, enacted two years later.
In contrast to cleaner manufacturing, which focuses on a particular firm or production process, eco-industrial parks (EIPs) rely on collaboration among firms to enhance resource efficiency while minimizing environmental consequences. EIPs are based on the concept of industrial ecology, which explores energy and material resource flows for long-term use and production using analogies to natural ecosystems (Zhu et al, 2018). More specifically, they are influenced by IS, which considers opportunities for by-product exchange, utility and infrastructure sharing, and joint service provisioning among co-located businesses (Chertow et al. 2008). In 2003, China enacted a regulation that governs the application, appointment, and management of national eco-industrial demonstration parks, making EIPs a national policy. Originally, EIPs were mostly made up of manufacturing companies, either with a dominant sector, such as a chemical industry park, or with a complex mix of industries. Later on, some EIPs were created that were dedicated to the recycling industry was also promoted. These policies are all production-oriented, whether they are for a particular process, a firm, an industrial park, or a wider area than a park. The primary goal is to increase production efficiency and environmental performance.

In the 1980s, a call for energy conservation was issued, followed by a call for raw material conservation in the early 1990s. Since the mid-1990s, clean technology guidelines and catalogs have been produced and revised.

Cleaner development policy, which focuses on incorporating clean technology into enterprises and industrial processes, was strongly supported from 2000 to 2004 and has subsequently accounted for the bulk of production-oriented policies. In the year 2000, the metal refinery, petrochemical, chemical, paper, food, and textile sectors produced the first leading catalog of cleaner production

methods. Two years later, the Cleaner Production Promotion Act was passed, with a wider scope that included agriculture, service, construction, and mining. In the years that followed, the technology catalog was enlarged, and comprehensive plans and regulations were developed. Financing assistance, on-site healthier manufacturing audits, and product energy quality labeling were all heavily promoted.

While the first EIP policy was implemented in 2003, a series of policies enacted between 2006 and 2008 made EIPs more widely promoted. EIPs are primarily promoted by national recognition and presentation, as opposed to cleaner manufacturing, which heavily relies on technology catalogs. Local officials benefit politically from this strategy because they can be respected, sponsored, and encouraged by higher-level administrations. To be accepted as an EIP, a park must follow specific criteria, operate well per a specific indicator approach, and be inspected and evaluated by specialists. Aside from the MEP-led EIP initiative, the NDRC and MIIT have supported circularity reform at the industrial park level, resulting in a wider coverage of industrial parks and increased financial support. Different indicator systems for measuring the CE output of industrial parks have been established depending on the particular programs. They operate on the basis of four dimensions: economic growth, resource recycling and productivity, environmental control, and management.
Construction, review, and nomination as a demonstration site by the administrative agency are all part of the application process.

Following 2010, new policy recommendations targeted at decreasing greenhouse gas emissions and industrial strategies were presented.
Low-carbon growth became an overall primary goal. Significant finance and investment have benefited the remanufacturing, energy-saving, and environmental-protection businesses in particular (Zhu et al., 2018).
Production-oriented strategies have progressed beyond single firms or industrial parks to include industrial growth, which encourages CE on a broader scale while addressing several policy goals.

Waste Policies

Concerns regarding industrial pollution and waste first surfaced in China in the 1950s and 1960s, receiving little attention at the time. Because of the much greater volumes associated with industrial growth, these concerns increasingly became salient with respect to hazardous waste treatment in the 1970s and 1980s, and later for non-hazardous waste treatment as well.

During the 1990s, the State Environmental Protection Administration created a set of policies and guidelines to prevent solid waste pollution. Policy-making processes had found a ground to stand on after the introduction of the Law on the Prevention and Control of Environmental Pollution by Solid Waste in 1995, later updated twice, in 2004 and 2016. The law established a clear link between waste reduction and CE initiatives like cleaner manufacturing and CUR. These waste rules, unlike other types of policies, have an indirect impact on CE flows. They directly refer to waste flows and the related environmental problems by providing higher treatment rates. These interventions partially reintroduce waste flows into resource extraction and manufacturing systems, resulting in CE flow, as shown by the dotted lines.

Use-Oriented and Life Cycle Policies

Since the industrial sector consumes the majority of energy and resources and causes the most environmental harm, the usage process has received less attention than the extraction and development phases. One of the few examples is the National Development and Reform Commission's announcement in 2008 of a rule on remanufacturing of car parts, which increases the lifetime of in-use auto parts. Although the regulation necessitates manufacturers' participation, the aim is not to increase the production phase's efficiency or environmental performance. Rather, the aim of the strategy is to keep more goods in use while reducing demand for output and resource extraction.

The State Council's Promotion Plan for Extended Producer Responsibility (EPR) Policy, announced in December 2016, is a more recent example. The aim of the policy is to incorporate environmental impacts associated with product delivery, usage, and disposal into product design and production decisions. The EPR policy, like the remanufacturing policy, controls producer activity, but it is focused on consumption.

Focusing on the usage process of the product life cycle also expands the reach of policies beyond that phase. Similarly, other policy initiatives can have several stages. The State Council, for example, first supported the circular economy in 2005 with the goal of enhancing resource output and lowering pollution. Per-GDP electricity, water, and a few forms of resource consumption; recycling and reuse rates of industrial waste and mining tailings; shares of recycled output in total production of certain metals; and overall amount of waste generation were among the policy indicators.

Although the usage process was briefly addressed, it was only after the passage of the Circular Economy Promotion Law in 2008 that it became more strictly governed.
Another instance of broader reach is the endeavour to develop a conservation-oriented community, as indicated by the State Council in 2005. As with the Circular Economy Promotion Law, a conservation-oriented society includes production, distribution, and consumption. The difference is that it places a greater emphasis on final consumption, while the circular economy places a greater emphasis on upstream output. While both policies cover a wide range of issues, a thorough examination of the whole scheme necessitates an explicit life cycle perspective.

The Development of CE policies

Before the 1990's - comprehensive utilization of resources

There has been a long history of attempts in China to establish a CE that spans more than half a century. Early programs, which were largely resource-oriented, were seldom conceived as individual CE policies. They were instead included in other reform schemes, strategies, and guidelines. In the late 1970s and early 1980s, several of these policies aimed at promoting CE activities arose, all with an emphasis on comprehensive resource use (Zhu et al., 2018):

Before the collapse of the Berlin Wall in 1989, a period where environmental management was in its infancy, China's environmental protection strategy was similar to those of other centrally planned economies, like as the European nations in the 1970s and early 1980s. Citizen participation is limited; there is no autonomous environmental movement or non-governmental organizations (NGOs); and international agreements, organizations, and institutions receive little attention. There is a heavy focus on central state authority, particularly on the Communist Party of China (CPC), with limited room for manoeuvre for decentralized state entities, parastatals, and private enterprises; and a focus on large-scale technological developments (in terms of hard technology). Problems with cooperation between state authorities and agencies, as well as the environmental authorities' limited power were also an inherent part of this first period.

The continuous evolution of China's environmental reform plan did not have a linear characteristic. A degree of discontinuity in Chinese environmental reform is due to two key issues (Mol A. et al., 2006). First, China's economic, political, and social changes over the previous two decades have had an impact on the original model of environmental control. China's environmental governance model has shifted away from that of centrally planned economies as a result of economic transformations toward a market-oriented growth model, decentralisation dynamics, growing openness to and integration with the outside world, and bureaucratic reorganization processes. Second, China has seen the inefficiencies and ineffectiveness of its original approach to environmental governance. The Chinese government's major involvement in environmental protection began about the same time as the commencement of economic reforms in the late 1970s. Pollution control began in the early 1970s, particularly after the Stockholm United Nations Conference on the Human Environment in 1972. Although its major development happened after the establishment and implementation of environmental laws and regulations beginning in the late 1970s, with particularly strong acceleration in the 1990s, a National Environmental Protection Office was founded in 1974, with equivalents in the provinces. Following the passage of the state Environmental Protection Law in 1979, China began gradually developing its environmental regulatory structure, later updated in 1989. In 1984, environmental protection was declared a national basic policy, and key principles for Chinese environmental protection were proposed, including "prevention is the most important, backed by control," "polluter responsible for pollution control" (as asserted in the 1979 environmental law), and "strengthening environmental management."

Following that, a national regulatory framework was established, which included a series of environmental laws (covering all key environmental sectors, beginning with marine and water protection in 1982 and 1984), executive regulations, standards, and measures.

Since 1989, the Department of Pollution Control of the Chinese Ministry of Environmental Protection has performed a Quantitative Examination of Comprehensive Control of Urban Environment (QECCUE). The QECCUE's main goals are to improve environmental protection at the city level, speed up the construction of environmental infrastructure, and include environmental considerations into the development decision-making processes of cities.

1990's leadership - cleaner production

Since the late 1990s, there have been a growing number of initiatives aimed at developing a comprehensive policy structure. For starters, policymaking became more rapid. Almost every year, a number of proposals were being released. Policies were created or revised more regularly Second, policy composition altered from a sole focus on resource use to a high proportion of production-oriented policies, which has lately switched to consumption-oriented and multistage policies. Third, legislation was enacted, first for solid waste and energy efficiency in the 1990s, then for cleaner manufacturing promotion in 2003, and lastly for CE and renewable energy (Zhu et al., 2018).

Over the previous two decades, the enactment of numerous environmental laws, measures, and regulations has been accompanied by a gradual expansion in the bureaucratic position and capability of these environmental authorities. For example, the NEPA was elevated to the National Environmental Protection Agency (in 1988) via the National Environmental Protection Bureau, and it was given ministerial status as SEPA in 1998. By 1995, China's 'environmental state' employed over 88,000 people, and by 2004 it had risen to over 160,000. "*Clearly, the previous 15 years... have seen the creation of a vast institutional system nation-wide and the development of its rank*" writes Jahiel (1998, p. 776) of the environmental bureaucracy. These improvements have been accompanied by an increase of EPB authority — particularly in the cities. Although the expansion of the 'environmental state' sometimes met stagnation, over a period of 20 years the growth in quantity and quality of the officials is impressive (especially when compared with the shrinking of other state bureaucracies). During this time period, The State Development Planning Commission (SDPC) and the State Economic and Trade Commission (SETC), in addition to SEPA, are important national state bodies in environmental protection, particularly following the recent governmental reorganization in 1998.

Although significant information distortion, discontinuities in environmental statistics, and the lack of longitudinal environmental data in China should make us careful about reaching any final conclusions, these administrative initiatives may have led to some environmental gains. Data on emissions and environmental quality are normally included in SEPA's annual "Report on the State of the Environment in China," and they show notable variations in data presentation between 1997 and 2004.

China's rising global integration (particularly economic, but also political) has an impact on domestic environmental regulation. However, in comparison to the major influence of external pressure and support on national environmental policies in other Asian countries, China has been hesitant to accept assistance under strict environmental conditions. The Three Gorges Dam is an excellent example of China defying international criticism and threats to withdraw international funds for the project. All in all, despite having signed and ratified the majority of the main Multilateral Environmental Agreements (MEAs), Chinese authorities are still unwilling to embrace strict environmental measures even if it could have a negative impact on international negotiations.

On less contentious problems, however, foreign assistance programs have clearly influenced and/or contributed to China's environmental policies and programs. Between 1991 and 1995, China received $1.2 billion in foreign money for environmental preservation (Vermeer, 1998). China has recently attracted a lot of international attention as well as financing for the environment, thanks to many MEAs and multilateral institutions including the World Bank, the Asian Development Bank (ADB), the Global Environment Facility, and the United Nations Environment Programme. By the end of the 1990s, the World Bank and the Asian Development Bank had combined to grant US$800 million in yearly environmental loans to China. Asuka-Zhang (1999) emphasizes the importance of Japanese environmental ODA and environmental technology transfer to China. Around 15% of China's overall environment-related spending came from bi- and multilateral lending and aid by the end of the 1990s, according to estimates (Mol et al., 2006). Foreign initiatives and international specialists had a significant impact on the development and implementation of ISO 14001 certified environmental management systems and cleaner production, ultimately leading to the passage of the Cleaner Production Promotion Law in 2002 (Mol et al., 2006).

China began promoting and implementing cleaner production (CP) in the 1990s, and the first CP project was launched in 1993 with funding from the World Bank and the United Nations Environment Programme. Since then, more than 15 other bilateral and multilateral comprehensive cooperation programs with an emphasis on CP have been implemented, resulting in various pilot projects in industries and businesses.

There has also been the creation of a legislative network of national and local CP policies, as well as an institutional network of promotional centres. In 1993, the State Environmental Protection Administration (SEPA) and the UNIDO/UNEP Cleaner Production Programme formed a National Cleaner Production Centre (NCPC), which is now connected to 20 more local and industry-based CP centres, and 550 CP training sessions were conducted in China, with over 16 000 participants, up until May 2000. China also initiated a national CP demonstration program in May 1999, choosing ten cities (Beijing, Shanghai, Tianjin, Chongqing, Shenyang, Taiyuan, Jinan, Kunming, Lanzhou, and Fuyang) and five industrial sectors (petrochemical, metallurgical, chemical, light industry, and shipbuilding) to participate in pilot CP projects. According to Hicks et al. (2007), 700 CP demonstration projects had been initiated in 24 provinces throughout the country by the end of 2001.

The State Environmental Protection Administration's "Ninth Five-Year Plan for Environmental Protection and the 2010 Long-Term Goals" proposed Model City for Environmental Protection in 1997, later upgraded to MEP in 2008. It was based on the QECCUE, with economic and social metrics added to ensure that the model cities are not only environmentally sustainable, but also economically stable and socially harmonious. Unlike the QECCUE, the MEP assigns goal values to metrics, and only cities that meet such targets are eligible to become MCEs.

2000s leadership - the pilot stage of the circular economy

The State Environmental Protection Administration (SEPA) advocated the circular economy concept in 2002, with explicit criteria for its development, planning, and operation. The National Development and Reform Commission (NDRC) was established by the State Council in 2004 to oversee its implementation and promotion. NDRC announced eight initiatives to help with CE implementation, including "initiation of legislation procedure, pilot projects, the application of economic instruments, research and development (R&D) efforts, industrial restructuring, performance indicators, financing mechanism, and training and education" in support of the development strategies.

China's State Council issued a policy statement in 2005 (State Council, 2005) identifying the nation's heavy resource exploitation's economic and environmental concerns and recognizing the circular economy as the primary means of coping with them. Since then, the country's planning agency, the National Development and Reform Commission (NDRC), as well as bodies like the Ministry of Environmental Protection, have developed circular-economy principles and promoted industrial symbiosis exemplars, such as the Rizhao Economic and Technology Development Zone.

NDRC released the first list of CE pilot models, which included 56 businesses, 13 industrial parks, seven provinces, five cities, and one town. In 2007, the second list, which included 178 businesses, was released. The policies of taxation, fiscal, pricing, and industry were all implemented. A fund has been established to help industrial parks become eco-industrial agglomerations. Tax breaks were offered to businesses in the reuse sector. The NDRC worked with financial regulators to fund the programs through concessionary loans or direct capital financing, including China's central bank and banking and securities regulatory agencies.

In China, the state apparatus continues to play a major role in environmental preservation and reform. For some time, the state's critical role in environmental protection and reform will be protected by the nature of the present Chinese social order and the nature of the environment as a public benefit. The impressive rise of Environmental Protection Bureaux (EPBs) at all governmental levels articulates environmental interests in particular. However, this system of (local) EPBs is the source of the most common criticisms from Chinese and foreign environmental experts. Both higher-level environmental authorities and municipal governments are significantly reliant on local EPBs.

According to Olabode (2019), China's environmental state is definitely through a transitional phase that has been dubbed "political modernisation" elsewhere, in which traditional hierarchical lines and power divisions are being changed. Although the political modernisation processes in China's environmental policy differ from those in European countries, the reforms are headed in the same direction: greater decentralisation and flexibility while moving away from a rigid, hierarchical, command-and-control system of environmental governance. Local EPBs and governments are increasingly being offered – and accepting – more leeway in setting environmental goals, strategies, financing models, and institutional frameworks. This is in line with general decentralization trends in Chinese society, but it is also fueled by official failings in environmental regulation. The trend is for local governments to have more influence and decision-making authority, while Beijing, both through central state structures and the CPC, loses control. However, decentralisation does not always imply improved environmental protection in China, as local governments sometimes prioritize economic expansion and investments above the progressive development of environmental policies and strict enforcement of environmental regulations and standards. Decentralisation in China's environmental policy is hampered by the lack of critical corrective procedures, since both an engaged civil society and accountability systems are underdeveloped. Nonetheless, these levels of public participation and possibilities fall well short of Western traditions and ideals. However, a greater degree of autonomy for local governments has resulted in an increasing variation in how Chinese provinces and municipalities cope with local and regional environmental concerns, for better or worse. Decentralisation trends in China, like in other nations, are accompanied with counter-tendencies. Environmental protection projects, for instance, are increasingly financed centrally. The central state has also responded to the growing relative autonomy of local authorities by refining their system of evaluating towns and town governments, and including environmental indicators in it, such as the Urban Environmental Quality Examination System and the National Environmental Model City.

The separation of state-owned enterprises (SOE) from the line ministries and local governments (in the case of Town and Village Enterprises) that were initially accountable for them has resulted in a second change in environmental governance. Decentralization in firm management facilitates the assimilation of new and more energy and ecologically efficient technologies into Chinese state-owned firms. The transition of decision-making on production units from political and party influence to economic areas, where market and profit logics predominate, is a slow but continuous process. However, in most cases, the relationships between these businesses and government agencies are still complicated, and local governments are still successful in extracting funds from profitable businesses for public works or other purposes, subsidizing inefficient businesses, and influencing business decisions. Despite the fact that municipal governments, in particular, are frequently hesitant to give up direct relationships with successful businesses due to financial ties, there is an undeniable trend for businesses to gain more autonomy from political actors. Because the 'protection' of these SOEs by line ministries and bureaux at all levels of government is less direct, this development offers up prospects for more strict environmental management and enforcement.

Whereas the national environmental authority in Beijing has reinforced its standing in relation to other ministries and agencies, this is not necessarily the case at the local level, where EPBs are, more often than not, part of a state-owned enterprise.

Environmental NGOs and other social organizations in China have a recent history of articulating and lobbying for environmental concerns and civil society concepts among governmental and economic decision-makers. The first environmental NGO was founded in the mid-1990s, hence this sector has a very brief history. Government-run NGOs, such as the Beijing Environmental Protection Organization and the China Environment Fund, dominated the environmental 'civil society' sector for a long period. Because of their tight ties with government agencies, they had and still have more registration and manoeuvring flexibility. These GONGOs express environmental interests and bring them into state and market institutions through tight networks with policymakers and their specialist expertise. At the same time, environmental NGOs are growing fast, despite the fact that they are still heavily influenced by the Chinese government. These NGOs, which are largely local or provincial, are frequently expert or awareness-raising organizations, such as Global Village, rather than hostile or confrontational.

De Burgh (2003) examines the recent big changes of this period in Chinese journalistic practices and media in an intriguing study. Parts of the media have been allowed economic independence after decades of state ownership and control. These developments put additional expectations on newspapers to acquire a large part of their revenue from ads (up to 60% in newspapers) and to pay greater attention to customer preferences.

The Chinese media plainly serves two masters: the Party and the market, and they appear to be continually pushing the boundaries of what the Party will tolerate, which appears to be a changing goal. Global media, including as satellite television, are still heavily reliant on Chinese authorities in this transitional period, and can only transmit and sell under certain restrictions for specific markets Environmental concerns are increasingly more popular, resulting in more frequent reporting of environmental accidents, disasters, and routine occurrences of pollution exceeding norms in China. The Internet has increased the opportunities for free media access and creation, yet the state is still present. The Chinese government is attempting to maintain control over the Internet by monitoring consumer Internet usage, demanding registration with local security agencies, and restricting linkages or gateways between national and foreign networks. It bans access to 'undesirable' websites, shutters websites, restricts access to and creation of news sites and weblogs, intimidates current and future users, and imposes stringent regulations on internet service providers. Not unexpectedly, the government actively supports international requests for more state control of the internet, such as those made at the UN World Summit on the Information Society in Tunis in November 2005.

The CE law was passed by the standing committee of the Chinese 11th National People's Congress on August 29, 2008 and was signed by Hu Jintao and went into effect in 2009. It mandated local and provincial governments to include such issues in their investment and growth plans. Coal, steel, electronics, chemical, and petrochemical industries were all given targets.

The table illustrated below shows the most important passed laws supporting the circular economy during the 2000s decade:

Table 2 Laws supporting CE years 2000 -2010

Cleaner production promotion law	2002
Law for environmental pollution of solid waste	2004
Law for renewable energy	2005
Circular economy promotion Law	2008

Circular economy promotion Law

On August 29, 2008, during the fourth meeting of the Standing Committee of the 11th National People's Congress, the Law for the Promotion of the Circular Economy was passed, and it went into effect on January 1, 2009. The law was described as a vital strategy for national economic and social growth, fostering resource efficiency, environmental protection, and long-term development. Circular economy techniques will only be applied, according to the law, if they are technologically viable, economically feasible, and suitable for conserving resources and protecting the environment. Yuan et al. (2008) stated in his research on China's CE strategy that the objective is to create the closed energy and material cycles seen in nations like Germany and Sweden. Individual enterprises, eco-industrial parks, and eco-cities/municipalities were to be part of China's circular economy implementation.

China's CE was influenced considerably by German and Japanese policies and ideas. Heshmati (2015) referred to China's CE legislation as the world's third, saying that Germany and Japan had CE laws as well. This was also emphasized by the minister in charge of the development of CE, Yang Chun Ping (EMF, 2018).

The State Council is in charge of the administration of circular economy promotion, which includes organizing, coordinating, and regulating national circular economy policies. Any new industrial policy developed by the government must meet the criteria for supporting a circular economy, according to the law. Industries must put in place management systems that reduce resource consumption and waste generation while also boosting resource recovery and recycling (NPC, 2008). The law states that the Chinese government supports scientific research, development, promotion, and international collaboration in the field of circular economies, as well as scientific education, publicity, and popularization. The goal is to offer a greater understanding of how to save resources and protect the environment (NPC, 2008).

Some enabling and essential policies were put in place to support the CE law before it was passed.

China's CE law was the consequence of a top-down strategy. This implies a command-and-control mechanism between the government and the people. Many detractors criticize the CE plan's insufficient integration of market-based solutions and public participation. Others emphasize the use of vertical and horizontal techniques in CE deployment. The former indicates that CE moves from micro to meso (eco-industrial parks) and macro (provinces, regions, and cities), whereas the

latter involves a relationship between industries, infrastructure, environment, and social consumption systems. Su et al. (2013) present a three-layer circular economy implementation scheme in China. Its results are in the table below.

Table 3 Implementation structure of CE in China. Data Source: Su et al. (2013). A review of the circular economy in China: moving from rhetoric to implementation.

Areas	**Micro**	**Meso**	**Macro**
Design	Eco-design	Environmentally friendly design	Environmentally friendly design
Production	Cleaner Production	Eco-industrial Park	Eco-city Eco-municipality Eco-province
Consumption	Green purchase and consumption	Environmentally friendly park	Renting service
Waste Management	Product reuse and recycle system	Waste trade market Industrial symbiosis	Urban symbiosis

Eco-design is included into the early stages of product design at the micro level to ensure that energy consumption is decreased throughout the product life cycle. Cleaner production is at the heart of CE adoption at this level. It comprises resource reuse and by-product recycling to meet dual environmental and economic performance goals, as well as the reduction of hazardous materials and resource consumption, energy efficiency, and pollution and waste emissions.

Environmentally friendly designs that assure resource efficiency, life cycle thinking, and product upgradability are advocated at the meso level to increase industrial symbiosis. Similarly, resource reuse and recycling within industrial parks and clustered enterprises is critical for CE adoption. This is to guarantee that resources are distributed efficiently within the region. "*A community of manufacturing and service enterprises pursuing superior environmental and economic performance via collaborative management of environmental and resource challenges*" according to the definition of an eco-industrial park (Olabode, 2019), Ren (2007) explained that eco-industrial parks have two sorts of activities: new park development and 3R integration into existing parks. These activities may be carried out in two ways: through the creation of eco-industrial chains among park businesses and through the use of shared infrastructure systems for common supply. Guigang national demonstration EIP, Nanhai national demonstration EIP, Tianjin economic development area, Suzhou Industrial Park, Sichuan Tuopai brewing EIP, Xi'an high-tech zone, and Yantai development zone EIP are examples of eco-industrial park developments in China. Waste from collaborating firms is used as raw materials or part of materials in these EIPs. These EIPs have been effective in conducting waste swaps for ash, sludge, plastics, wood, and paper, according to Shi and Yu.

Product collecting, processing, storage, and distribution systems at the regional, municipal, provincial, and city levels are critical for establishing environmentally friendly production and consumption systems and energy savings at the macro level. According to Su et al. (2013), there are all-encompassing co-operative networks connecting industries and industrial parks in the

producing region from the primary to tertiary sectors: "*The 3R principles are achieved by the redesign and rearrangement of city's infrastructure and industrial layout according to regional characteristics, as well as phaseout of the heavy polluting enterprises, while supporting high-tech industries*" (p. 217).

Ren (2007), on the other hand, identified the following macro-level categories of activities:

• Development of industry for waste reuse, recycling, and safe treatment;

• Eco-agriculture development, which has a longstanding history and is rich in many models such as plant-livestock farming/fishing-food production, biogas fertilizer model for livestock, and food based ecological and organic food;

• Public green procurement, energy conservation in government offices and families, green communities, green hotels and restaurants, green structures, and certifications for ecologically friendly and energy-saving items are all examples of actions promoting environmentally friendly consumption.

Shenzhen in Guangdong, Wuhan Huashan in Hubei, Zhenjiang Guantang in Jiangsu, Kunming Chenggong in Yunan, Sanming in Fujian, and Zhuhai Hengqin in Guangdong are some of the cities and districts suggested as low-carbon cities. The goals of creating low-carbon cities are to minimize carbon emissions, while preserving economic growth, control and gather data on greenhouse gas (GHG) emissions and encourage citizens to consume green products. Economic growth, energy consumption, urban building, government backing, and household consumption are among the benchmarks set by the Chinese government for low-carbon cities. Nonetheless, the notion has been found to have certain flaws. For example, the high cost of CE activities, the lack of industrial incentives for green activities, and low public awareness of CE activities, as well as insufficient financial support and the lack of CE evaluation standards to track its progress. Some of the challenges of CE in China have been identified as a lack of planning guidelines, a lack of understanding, experience, and knowledge among local officials and others about CE project implementation, and a lack of clarity between the concept and other standard environmental protection planning concepts (Olabode, 2019).

11th FYP

The 11th FYP (2006 – 20010) has been called a revolutionary plan because it departs from the vision of the previous administration by promoting a more people-oriented vision and introducing a new model of scientific development.

The new plan represents a real turning point especially in terms of environmental protection. In fact, for the first time, the circular economy was given its own chapter.

In the first part, entitled "Guiding principles and development objectives", it is in fact stated that, in order to accelerate economic transformation, achieving, so, the goal of sustainable development, it is necessary to implement the conservation of resources as a basic national policy, develop a CE, protect the environment, accelerate the construction of a savings-oriented and

environmentally friendly society, promote economic development in harmony with the population, resources and the environment, and embark on a new path of industrialization that is clean and safe.

In the section of the new plan dedicated to the environmental theme, "Construction of a society aimed at conserving resources and respectful of the environment", for the first time an entire chapter is dedicated exclusively to the theme of the circular economy, understood as a new strategy of development that starts from the reflection on the interconnected relationship between ecosystem and socio-economic system. In the twenty-second chapter of the section, entitled "Development of the circular economy", (发展 循环 经济, fazhanxunhuan jingji), the need to give absolute priority to savings and to establish, in accordance with the 3R principles, a system of resource recycling for the whole of society, especially in the areas that concern the extraction, production, and generation of waste and consumption.

Of particular relevance is the fifth section of the chapter which, in addition to promoting an efficient use of resources, requires the creation of an extended producer responsibility system to encourage the reuse and recycling of unused products and the launch of demonstration projects of the circular economy in the main industrial sectors, in industrial parks and in urban areas.

On this line, the 11th Five-year Planning Outline for National Economic and Social Development set up two mandatory targets: reduction of energy consumption per unit GDP 20%; reduction of the total volume of SO2 and COD released by 10% by 2010.

To attain this level of political commitment, nearly all governmental and societal resources must be dedicated to energy conservation and pollution reduction programs.

China is putting eleven steps in place to do this. Restructuring industrial sectors and energy components, technological enhancement, national priority projects, and resource pricing reform are among the 10 initiatives. Under each metric, extremely specific instruments have been prepared in accordance with the appropriate policy planning. In the area of pricing policies, for example, the price of electricity used by industrial enterprises with high energy use and high pollution production is higher than the average price, and manufacturers of high-energy content and heavily polluting products such as steel and aluminum no longer enjoy preferential tax treatment when exporting those products, which was only put in place in 2007 (Yong, 2007).

2010s leadership – the central stage of the circular economy

It's largely agreed by researchers in the field of CE that its rapid development started from 2009.

The CE was included in the government's medium-term focus 11th five-year plan (2006–2010) and upgraded to a national development strategy in the government's 12th five-year plan (2011–2015) for national economic and social development, with decrees and laws in place to encourage cleaner production, pollution prevention, and waste control.

The policy efforts during this decade can be summarized as such:

- **12th Five-Year Plan** three level strategy and pilot cities;
- **Circular Economy Development Strategies Action Plan** (2013), based on 3R framework and expertise from demonstration projects (industrial parks);
- in 2013, 2015, and 2016, the State Council released **three ten-point action plans** to combat air, water, and soil pollution in order to put the latest laws and regulations into effect (P.R.C Ministry of Environmental Protection (MEP), 2013);
- On 1 April 2016, the United States and China, which together are responsible for almost 40% of global emissions, issued a joint statement confirming that both countries would sign the **Paris Climate Agreement**;
- the newly amended **Atmospheric Pollution Prevention and Control Law** went into force in early 2016, focusing on addressing the causes, total discharge, and density of contaminants;
- The new **Environmental Protection Law** (EPL), which was amended and implemented on January 1, 2015, is the most progressive and robust environmental law in China's environmental protection history. It provides guidelines for combating emissions, enshrines the public's environmental right-to-know, creates a system for environmental public-interest litigation, and strengthens local governments and law-enforcement agencies' transparency. In comparison to the previous EPL, the current EPL offers a much clearer structure and guidance for better environmental governance in China. Another major component of the EPL is a chapter on information disclosure and public participation, which discusses improving data collection and reporting measures like principles, scope, content, methods, and procedures, as well as oversight of environmental information disclosure, including that for businesses;
- **13th Five-Year Plan;**
- 2017: **Extended Producer Responsibility Plan** (EPR, electronics, automotive packaging as priorities), **National SWORD** (ban of waste imports), **Guideline on Promoting Sharing Economy**, **CE Development Lead Action** (broader value chain and leverage of digital revolution).

12th Five-Year Plan

The Twelfth Five-Year Plan was discussed during the Communist Party of China (CPC) 17th's Central Committee's fifth plenary session in mid-October 2010, the same session in which Xi Jinping was elected Vice Chairman of the Central Military Commission. Following the plenary session, the National People's Assembly approved a comprehensive plan proposition aimed at addressing growing inequality and creating a more sustained growth setting by focusing on improving a more equitable distribution of wealth, increased internal consumption, and improved social infrastructure and social welfare programs.

The approach represents China's efforts to rebalance its economy by focusing on consumption rather than investment, as well as development away from urban and coastal areas and toward rural and innerland areas. The strategy also maintains the Eleventh Five-Year Plan's aims of improving environmental protection and speeding up the opening and reform process.

As reported in the premise of the plan, the development of the circular economy represents an important measure to implement the government's strategy, aimed at building an ecological civilization. The main objective of the plan, in fact, is to accelerate the transformation of the country's economic development through the construction of a society attentive to the conservation of resources and respectful of the environment, achieve sustainable development and, therefore, improve the overall societal level. In order to guide and promote the accelerated development of the circular economy, it is therefore essential to adhere to its strategic planning.

The strategic plan marks a turning point in the way of understanding the circular economy, outlining for the first time the ways of implementing the model on three different scales: the firm level, the industrial park level, and finally, the province level. The third chapter, in fact, is dedicated exclusively to the development of a system circulate in the main industrial sectors.

In 2011, the Twelfth Five-Year Guideline set goals to increase GDP by around 8% annually, spend 2.2 percent of GDP on research and development by 2015, reduce the population to below 1.39 billion by 2015, readjust income distribution to close the yawning gap, implement prudent monetary policy, and intensify fiscal policy. By 2015, the goal was to reuse 72 percent of industrial solid waste and increase resource efficiency (economic production per unit of resources used) by 15%.

The plan outlined a three-pronged strategy: ten major programs focusing on industrial waste recycling, industrial park conversion, remanufacturing, urban mining, and waste-collection and recycling system development; 100 demonstration cities such as Suzhou and Guangzhou; and 1,000 demonstration enterprises or industrial parks throughout the country. According to the NDRC and the finance ministry, by 2015, 50 percent of national industrial parks and 30 percent of provincial industrial parks should have completed circular-economy reform programs.

Other 2015 targets included an 18.5 percent increase in energy productivity (GDP per unit energy), increasing water productivity by 43 percent, and increasing recycling industry production to 1.8 trillion yuan (US$276 billion) from 1 trillion yuan in 2010. Reusing at least 75% of coal gangue (worthless rock found in deposits) from mining and 70% of pulverized fuel ash, a by-product of coal combustion, from power production are among the others (Matthews & Tan, 2016).

These efforts are still guided by the State Council's "Guidance of the State Council on Promoting the Development of Circular Economy" issued in 2005, which lays out targets for establishing legal, policy, and institutional framework for a circular economy.

The Chinese government mostly accomplished its 12th FYP energy consumption and carbon and pollutant emissions reduction objectives, according to official Chinese data and independent analysis.

Since 2005, the National Bureau of Statistics has tracked progress on four indicators: resource intensity (resources utilized per unit GDP), waste intensity (trash per unit GDP), waste recycling rate, and pollution treatment rate. The People's Republic of China's National Bureau of Statistics. The National Circular Economy Development Index Achieved 137.6 in 2013 (NBS, 2015).

Resource and waste intensity has improved by 34.7 percent and 46.5 percent, respectively, by 2013, indicating that resource consumption (of metals, water, energy, and biomass) is decoupling from economic development in relative terms. Pollution treatment rates grew by 74.6 percent, including sewage treatment, decontamination of urban household waste, and reduction of main pollutants. The rate of garbage recycling and reuse increased by 8.2 percent.

China's resource intensity declined from 4.3 kilos of materials per unit GDP in 1990 to 2.5 kilograms in 2011, according to OECD data. However, as a result of its economic expansion, China's overall resource consumption increased fivefold during these two decades, from 5.4 billion tonnes to 25.2 billion tonnes (Mathews and Tan 2016).

13th Five-Year-Plan

The 13th Five-Year Plan (FYP) (2016–2020) established Chinese President and General Secretary of the Chinese Communist Party (CCP) Xi Jinping's vision for China, which was confirmed by the National People's Congress (NPC) in March 2016.

The overall objective was to create a “moderately prosperous society in all respects” through higher-value-added manufacturing and domestic consumption. At the core of the plan there were five principles on subjects of innovation, coordinated development, green growth, openness, and inclusive growth:

- Innovation, aimed at changing the Chinese economic structure into a better and more competitive growth model;
- coordinated development to resolve the growing disparities in regional economic development;
- green growth, which combines environmental protection and economic performance;
- openness, understood both as a greater willingness to attract foreign investment and a more active participation of China in the international market;
- inclusive growth, conceived as a more equitable sharing of prosperity on the part of the entire Chinese population and expansion of the social security system.

Following the line of development already indicated in the two previous plans, the new plan places greater emphasis on the need to make further efforts to protect the environment and on energy efficiency.

The new plan is made up of a total of eighty chapters, of which the tenth "Accelerating the improvement of ecosystems and the environment" is entirely dedicated to environmental issues and is divided into further sections that follow the following order: the construction of functional areas, the efficient use of resources, improvement of environmental governance, ecological conservation and restoration, proactive response to climate change, improvement of ecological security mechanisms and development of green industrial sectors.

The 13th Five-Year Plan for Economic and Social Development aims at improving regional environmental protection departments' (EPDs) independence from local governments and unifies

national monitoring and inspection systems. Cities and counties' environmental compliance and monitoring divisions will be reconfigured to report directly to regional EPDs rather than to local governments (Zhang, 2016). These reforms will be introduced in 17 provinces/autonomous regions as a pilot program, with the goal of completing them state-wide in 2018 (Finamore, 2016).

The laws and regulations outlined in the 13th Five-Year Plan, as well as their subsequent environmental protection program reform, reflect a paradigm shift away from an obsolete pollution control regime toward one focused on environmental quality targets and expectations.

On 14 May 2017, the NDRC and MOST jointly released the Circular Development Leading Action (循环 发展 引领 行动, xunhuan fazhan yinling xingdong) so that the strategies proposed in the 13th Five-Year Plan regarding the circular economy could continue to be implemented. The new guide for the development of the circular economy places more emphasis on the implementation of the principles of reduction, reuse and recycling in the product design phase, devoting more attention to the promotion of green design and to the complete management of the life cycle of a product, carefully evaluating, already during the design phase, the impact that the product will have on the environment.

The new guide for the development of the circular economy increases the objectives related to the transformation of industrial parks compared to the 2013 action plan, foreseeing that, by 2020, the circular transformation will involve 75% of industrial parks nationwide and the 50% of those at the provincial level.

An interesting part also concerns the introduction of control systems through the establishment of an environmental credit assessment system for companies (绿色 信用, luse xinyong) which includes information regarding the implementation of the extended producer responsibility system, information on company safety, on the quality of recycled and regenerated products.

An innovative element compared to the past can be seen in the importance accorded to the opportunities that can be drawn from the new technological and digital solutions. Already in the guiding principles of the plan, in addition to continuing to continue towards the direction of a green transformation (坚持 以 绿色 转型 为 方向, jianchi yi luse zhuanxing wei fangxiang) it insists that the new economic model must be guided by innovation and opening (以 创新 开放 为 驱动, yi chuangxin kaifang wei qudong). In the sixth chapter of the guide, technological innovation is considered a driving force that the government is ready to support and further develop through funds for research and development, information platforms and collaborations in the academic field. The industrial internet and, in particular, the Internet of Things[6], are among the strategic priorities of the government, so that manufacturing production processes can be increasingly digitized and, therefore, make national companies more competitive in the international context.

[6] The term Internet of Things (IoT) refers to the extension to "things" of the benefits of the use of the Internet that have hitherto been limited to people, allowing objects to interact with other objects and therefore with people in an increasingly digital way.

The new action plan reports that already in 30% of cities above the prefecture level, an online platform for the recycling of renewable resources has been built and that the annual scale of transactions that take place on the platform has exceeded 500 billion of yuan.

As far as openness is concerned, it is more evident the will on the part of the Chinese government to intensify the political strategy of going global, of which the One Belt One Road[7] project represents a decisive part, and to strengthen international cooperation in the context of circular economy, particularly in the recycling sector, expanding the scale of imports and exports of key technologies.

2020s leadership

On September 22, 2020, at the United Nations General Assembly, Chinese President Xi Jinping announced that China will increase its Nationally Determined Contribution (NDC) to tackle climate change by trying to implement more aggressive programs and interventions in order to reduce carbon dioxide emissions prior to 2030 and achieve carbon neutrality prior to 2060.

Since signing the Paris Agreement in 2015, the announcement is one of the most important indicators of progress in countries' attempts to combat climate change. China's recent climate promises are a welcome boost to morale at a time when the consequences of climate change have never been more apparent. The entire globe is now waiting to see whether the country can keep its promises.

In order to come close to zero emissions, China must immediately suspend or reduce investment, for the long-term economical nature of investments in itself, in carbon-emitting infrastructure that lacks carbon capture and storage capability, as well as dramatically boost the energy efficiency of energy-consuming equipment.

The country should also speed up large-scale demonstrations of carbon capture and storage from point sources of emissions, which could serve as a springboard for the development of promising frontier technologies like bioenergy with carbon capture and storage (BECCS) and direct air capture and storage (DACS). Scaling up BECCS and DACS research, development, and demonstration is also crucial.

Enabling green power dispatch — which prioritizes renewable and low-cost electricity over coal-generated electricity — and other incentives to encourage renewable energy, as well as mandating continuously revised industrial energy efficiency criteria and speeding up the electrification of transportation vehicles, are among the possible actions the country would need.

In the next several years, China must also encourage investment in storing energy, power grid, and hydrogen technologies, along with reducing demand for industrial products, such as steel, cement, plastics, chemical products, and so on. China must also establish industrial product alternatives;

[7] One Belt One Road (OBOR) is an ambitious economic and commercial development project initiated by Chinese President Xi Jinping, which focuses on improving connectivity and cooperation involving approximately 78 countries in Asia, Africa and Europe.

modernize and revitalize industrial energy supply; and facilitate a structural shift to low-carbon transportation modes.

Many of these stages are part of China's "new infrastructure" agenda, which includes 5G, IoT, Industrial Internet, Cloud Computing, Blockchain, Data Centers, Smart Computing Centers, and Smart Transportation.

Finally, China must fully utilize the potential of afforestation, wetland regeneration, and other natural-based solutions to boost carbon sinks, since this would benefit the environment, economy, and society.

Barriers

Although current success in pilot areas suggests a bright future for CE growth in China, it has not been without its challenges. Several obstacles that can obstruct or prevent the introduction of CE have been identified and consistently emphasized by a number of academics. The most easily recognized problems are a lack of reliable data, weak legislative enforcement, leadership and management, the absence of a standard framework for performance evaluation, a scarcity of advanced technologies, weak economic incentives and a lack of public awareness.

Lack of data reliability

Reliable data and information are the bedrock of environmental governance, allowing government agencies to establish ambitious goals, measure progress, and exchange information with all stakeholders. Each business will need not only internal data, but also external data as part of a larger economic system or network. As a result, an effective information system is required if decision-makers are to develop more ecologically and financially advantageous methods to organize and manage their resources and operations. In China, however, such formal information systems are uncommon. In most cases, decision-makers do not have access to reliable information, or it is not provided in a timely manner. Furthermore, various types of information also belong to different organizations as a result of decentralized management systems, further decreasing the efficiency of information exchange (Su et al., 2013).

However, the acquired data's quality is unknown, and the data that exists is frequently fragmentary, unpredictable, or untrustworthy. Even if the data is correct, it may be based on a resolution or scale that is inappropriate for the policy matter at hand. Furthermore, considerably greater uniformity is required among China's agencies, departments, and bureaus in order to enable data exchange. This may be achieved by adopting similar data and communication standards. Such flaws obstruct the creation of an accurate picture of China's pollution. The current situation of pollutant discharge statistics in China exemplifies the difficulties that many other aspects of environmental regulation face.

China has created a national total pollution control objective system for important pollutants that is applied locally, with local governments managing their accountable quotas of the national totals. Total pollutant discharges are primarily calculated using an environmental statistics system, with enterprises covered by the system responsible for providing discharge data. The data is subsequently collected, examined, and summarized by EPDs at all levels, who then submit it to EPDs at higher levels, with the MEP publishing total pollutant discharges in a Bulletin on National Environmental Statistics. However, firm personnel tasked with monitoring and recording environmental statistics data are frequently unprofessional, and environmental authorities' data filtering and synthesizing systems are rarely thorough.

For environmental statistics, the survey contents and range are fairly limited. VOCs (volatile organic compounds), petroleum, volatile phenol, and cyanide, for example, are rarely measured. This is in stark contrast to the US Clean Air Act's hazardous air pollution monitoring and reporting requirements, which are implemented by the US EPA (Environmental Protection Agency) and its

cooperating state environmental protection agencies and require the monitoring of a wide range of chemicals depending on geographic location. The correlation between total national contaminant discharges and local environmental quality control is uncertain, and the determination of such local quotas is not scientifically founded, due to the poor quality of records on pollutant spills, that may not properly represent local harmful emissions, let alone national combined pollutant discharges.

China, like the majority of countries, needs to enhance the quality of environmental data gathered in order to conduct environmental governance programs, track regulatory compliance, and satisfy public disclosure requirements.

Users of environmental information (citizens, government agencies, regulated enterprises) can be a valuable resource for identifying major errors, discrepancies, or shortcomings in the published data, and input from these users can be a precious asset for identifying major errors, discrepancies, or shortcomings in the published data. This information may then be utilized to improve the quality of the data and to assist modify environmental program policies, planning, and advice. Since the "Measures for the Disclosure of Environmental Information" took effect in 2008, China has achieved significant progress in terms of environmental disclosure of information. However, in China, the demand for information disclosure has not been completely enforced, obstructing public access to and examination of data and inhibiting public engagement.

In the information era, China has the benefit of establishing its environmental policy. New technology, such as mobile phones and social media apps, make it easier for the public to monitor polluters and have access to environmental data. Information technology also raises the stakes for polluters in terms of public oversight. For example, after China Central Television (CCTV) aired an investigative report on April 17 linking illnesses among students at a middle school in Changzhou, Jiangsu Province, to the school's location next to a trio of shuttered chemical plants, the social media hashtag "polluted school" received over 30 million views within a day after the CCTV report (Logan, 2006).

As a result of the TRI's accomplishment as an information disclosure initiative, the Organization for Economic Cooperation and Development (OECD) and the United Nations Environmental Program (UNEP) incentivised international support for the creation of a Pollutant Release and Transfer Registry (PRTR) for single nations. The United Nations Institute for Training and Research, or UNITAR, is presently assisting in the construction of PRTRs in around 30 nations. To produce a comprehensive PRTR research, the United Nations Institute for Training and Research (UNITAR) and the Commission for Environmental Cooperation (CEC), both in North America, decided to partner together.

China is attempting to build its own PRTR program. Tianjin's Binhai New Area initiated a PRTR between 2013 and 2014, endorsing, among other things, the creation of a list of chemicals to be released to the public, the creation of digital sites for EID (environmental information disclosure) documenting, and public sharing of data (EU-China Environmental Governance Programme (EGP),

2014). The EPA's effectiveness with information sharing has expanded to other efforts, including surface water pollutant discharge data, which is one of the agency's largest databases.

Lack of legislative enforcement, leadership and management

The Chinese regulatory framework relating to the circular economy is extremely fragmented and lacks a unified platform that includes legislative and political instruments that also take into account the system of incentives and disincentives that regulate the consumption of resources and pollution.

Geng and Doberstein (2008) explain that the ease and low cost with which resources are found incentivize industries to purchase raw materials rather than rely on recycled material which, on the contrary, requires further and more expensive processing.

Another prevailing problem is the superficiality and unclear application of the legislation. As pointed out by Wang (2007), there is too much time between non-compliance and implementation of the law and that the penalty available in the case of non-compliance is inadequate: very often, in fact, environmental crimes receive administrative sanctions rather than penalties and injured parties are not adequately compensated. Furthermore, it has been noted that the Chinese government tends to rely on administrative policies rather than market-based policies, which tend to generate strong imbalances between supply and demand.

Finally, the application of environmental regulations is also inefficient due to the lack of qualified personnel and officials who take more into account short-term economic benefits rather than environmental ones (Geng et al., 2010).

Enforcing the new Environmental Protection Law will not bring to China immediate and radical results. The EPL, like China's signing of the Paris Climate Agreement, which involves binding greenhouse gas emission goals for China, lays the groundwork for future laws and regulations. In order to identify and govern the essential aspects of the law, as well as to prevent air and water pollution, following rules and regulations must be developed and strictly implemented. As a result, the adoption of the EPL is an important move forward in China's efforts to improve environmental conditions and human health.

China will have to ensure that the environmental goals, priorities, legislation, and reforms outlined in the 13th Five-Year Plan and related steps are translated into action and strictly implemented in the future. At both the provincial and local levels, this will necessarily entail a strong regulatory strategy, increased scientific expertise, and increased enforcement and compliance power.

A transition towards a circular economic model requires integrated management efforts, the proactive participation of the main actors, public and private, at all levels of government and the transparency and predictability of both economic and administrative policy instruments (Ma and Ortolano, 2000).

Due to the complicated design of government agencies as well as the corruption of local authorities, the Chinese government's management system has been criticized. This has led not

only to failures in environmental management, but also to a lack of clear information. In China, systematic information systems are uncommon, and reliable information is rarely available or, if it is, not conveyed in a timely manner. Furthermore, various types of information typically belong to different agencies as a result of fragmented management frameworks, reducing the efficiency of information interchange even further. The lack of reliable and easily available data has also had effects on the monitoring system of the circular economy: without a transparent mechanism, the NDRC's ability to determine the validity and accuracy of the data presented by local authorities are seriously questioned. The central government, in fact, is only responsible for defining national standards without specifying values and objectives that should be used as benchmarks. This can discourage the enthusiasm of local governments which, in most cases, are unable to recognize at what level or what goals they should aspire to and achieve. Consequently, local government officials, being able to act in full autonomy and in order to garner greater political favors, often report only the best results, omitting the most accurate ones. Furthermore, given that the indicator system used in China is voluntary (Mcdowall et al., 2017) and can be pursued with different intentions, while the relatively wealthier eastern regions are more motivated to improve resource efficiency and environmental performance, the less developed ones in western China want to gain access to national financial subsidies (Xue et al., 2010). Therefore, various communication approaches should be adopted, incentives for broad educational programs and the drafting of mandatory reports, in order to improve awareness and knowledge of the circular economy.

Technology

The construction of a circular economy relies heavily on technology. Each of the three CE principles already listed necessitates advanced technology, as well as facility and equipment development and upgrading. However, China's overall technology level is considered as backward, and progress in the field of environmental technology is not adequate due to a lack of financial and technical support (Su et al., 2013). The main players in this regard are SMEs, which account for 99.88% of the total number of manufacturing establishments in China (Shi et al., 2007). Most of them do not have or have few incentives to carry out greener activities in terms of waste reduction and recovery, since replacing or updating obsolete technologies requires more time and more investments, thus, the potential economic benefit that drift is limited. An alternative way to overcome technological barriers has been identified in the transfer of technologies from developed countries but, in addition to the lack of financial and training resources (Geng and Doberstein, 2008), this process could be risky due to the "lock-in effect[8]", which implies a strong dependence on the support of exporters when technical failures occur (Xing et al., 2011).

[8] In this case we are referring to the term vendor lock-in, or the relationship of dependence that is established between a customer and a supplier of goods or services, such that the customer is in the condition of not being able to purchase similar goods or services from a different provider without having to incur significant costs and risks to carry out this step.

Weak economic incentives

The fourth constraint concerns the inadequacy of adequate financial instruments to integrate the circular approach and which prevent companies and producers from innovating and using more environmentally friendly technologies (Wang et al., 2008).

The main reasons for this have been identified in the fact that industrial and economic policies in China have mostly been devoted to the promotion of heavy industry, infrastructure and production, closely associated with the price of energy and materials (Andrew Speed, 2009). In fact, the increase in the prices of resources was severely limited and, even if prices were to rise, producers could easily pass the costs on to consumers in the form of higher selling prices. Furthermore, the government's insistence on maintaining tight control over energy prices for the end user stems from the desire to protect poor consumers and limit inflation. As noted by Amy S.P. Leung, the director general of the Asian Development Bank, the process of transforming the traditional economy into a low carbon one is difficult in any country, but it is even more difficult in developing ones, characterized by more growth. fast but with few "green incentives" (The China Council for International Cooperation on Environment and Development, 2018).

In order to mitigate this problem, the Chinese government has introduced several initiatives. For example, it actively promoted public-private partnership (PPP) programs, establishing information platforms and regulations to attract investors, launched measures to promote green public procurement, secured additional economic incentives, such as tax refunds and subsidies (Ellen MacArthur Foundation , 2018). Taylor et al. (2008), report that an important mechanism for unlocking capital for energy efficiency measures in China are energy service companies (ESCo) or energy management companies (EMCo), which provide a complete service model ranging from identification and design to financing and supervising the installation of energy efficiency projects, receiving a share of the resulting energy savings. It is expected that, with the more and continuous reforms of the banking sector and with the increase in the number of energy management companies, it will be increasingly possible for the latter to obtain financing directly from local banks.

In addition to weak economic incentives, lack of access to capital and uncertain repayment times, market failures also represent a barrier to the full implementation of a circular model. The imbalance between supply and demand is often determined by inadequate prices of the value of resources and negative externalities. The latter can be connected to an excessive use of raw materials, to the mismanagement of goods at the end of the consumption phase or to the impacts related to the production phase, such as methane emissions into the atmosphere or discharges of toxins that penetrate the soil. or in the surrounding water. Those who produce an environmental impact on the community, even unintentionally, do not bear the full cost, so when the price of the materials does not include the real cost of their negative impacts and when the commissions charged for the discharge of the effluents are too low, the incentive to keep materials in circulation is not strong enough, regardless of the social cost imposed on the rest of the company (The World Bank, 2009).

So far, the most used tools to restore the balance between demand and supply, "internalizing" these external costs, have been traced in the taxes on carbon emissions (carbon tax), on landfill disposal (landfill tax) and on pollution in general (pollution tax) (Kassoy et al., 2015). For example, for many years the price of coal in China was set below the actual production costs and did not

include the costs associated with environmental damage, making it the cheapest and therefore the preferred energy source. As coal prices rose to reflect the costs more fully to businesses, consumers reduced their use. In the urban context, on the other hand, the rapidly growing number of low-carbon zones and the introduction of access regulations aim to reduce externalities by including them, for example, in the cost of mobility based on combustion engines.

Consumer behaviour and social norms

Public participation is essential for the development of a circular program, both for the complexity of the concept and for the range of potential contributions that more than a billion Chinese consumers could make (Geng and Doberstein, 2008). However, in China, there is still a lack of human and institutional capacities to encourage public participation, even in pilot cities such as Tianjin where the model has been well implemented (Liu et al., 2009). Additionally, environmental management programs and facilities at many academic institutions are limited, and people's views on ownership of assets and their lack of trust in products take time to change. Mugge (2018) states that only if consumers can perceive broad, limited benefits and risks in remanufactured products and alternative access models, will they be motivated to repair and keep their products in use. On the one hand, therefore, there is the decisive role of companies in influencing consumer perceptions of circular products and services through innovative design models (Mugge, 2018) or, as suggested by Preston (2012), through a certification system o labeling for circular products; on the other hand, that of the government which should require people to abandon the passive culture of "disposable", typical of the linear economy, and to approach new methods of recycling / reuse and digital sharing mechanisms of the private sector, promoting a development model that focuses more on quality than quantity.

The political-social sphere

To better understand the full extent of the challenges that barriers pose against the full implementation of CE policies, we need first to understand the issues within the administrative organization of China. To do this, we'll be referring to Cavalieri R. lessons on law in China (2015).

With the rapidity of evolution in the Chinese legal system, Chinese doctrine is also beginning to pose itself in legal terms the issue of the organization of the public sphere.

In recent years, socio-economic development has contributed to modifying the configuration of the state-society relationship in China, a relationship from which most of the problems that the administrative organization has to face arise.

A first delicate issue concerns associations and non-profit social organizations (NGOs). These deal with issues relevant to state law, thus causing interference of varying degrees. NGOs are confronted with the constitutionally recognized right of association, the feasibility of which implies, however, difficulties. The debate on the issue is still open and current.

A second issue is represented by the village committees which represents one of the first forms of autonomy of the administrative apparatus in the Chinese system. These are self-governing

organizations that were born spontaneously by society and subsequently recognized in art. 111 of the Constitution.

The relationship between village committees and local governments has posed delicate problems sharpened by recent economic development which has intensified the need for autonomy with respect to control by local and central governments.

The rapid transformation of Chinese society and the consequent thrust of new interests and social demands also question the monolithic nature of the state considered as the only public legal entity.

Thanks to the change in the country's economic structure in recent years, administrative law is expanding in China, but requires a long time to settle. It follows that we are faced with an inevitably long historical process of which it is not possible to predict the outcomes on the political-social level.

The policy of ecological civilisation was approved into the CPC Charter at the 18th CPC National Congress in 2012, and has since been considered as a critical pillar of China's national development plan. The CPC issued a nine-section policy statement on ecological civilisation on April 25, 2015. It proposes norms, methods, and assessments to improve policy implementation, rather than simply restating high-level aims. The paper, most importantly, represents a shift in policy goals from economic growth to long-term development. It also acknowledges the importance of governance structures, policies, and performance incentives, and proposes a methodology for incorporating environmental protection criteria into government performance evaluation. Most importantly, the CPC text recognizes that the transition will necessitate governance improvements.

Development of societal discourses

By emphasizing the balance between economic, social, and ecological development, the integrative idea of sustainable development has promoted discourse and cooperation in China.

Under the leadership of Hu Jintao/Wen Jiabao, the idea of "Harmonious Society" was formed as an all-encompassing blueprint for social and economic progress toward a safe and prosperous China in result of increasing socioeconomic disparities and injustices in mainland China.

According to the former President Hu, a “Harmonious Society” is one which is ‘‘democratic and ruled by law, fair and just, trustworthy and fraternal, full of vitality, stable and orderly, and maintains harmony between man and nature.’’ These social values encompass cultural and environmental aspects as well as political and economic structures. Although the word is still in use, it may have lost some prominence in the light of the promotion of "Ecological Civilisation" rhetoric.

Following a debate on China's new economic and social aspirations in relation with establishing "a moderately well-off society" and fostering sustainable development, discourses on the "China Dream" emerged after 2013. Peggy Liu, an M.I.T. graduate, former McKinsey consultant, and founder of the environmentalist NGO Joint U.S.-China Collaboration on Clean Energy (JUCCCE), a

non-profit organization created in 2007 to develop an eco-liveable China, according to various experts, started the argument.

The term "Beautiful China" was coined by the political leadership at the 18th CPC National Congress in November 2013, around the same time or shortly after the China dream rhetoric emerged.

The term "Beautiful China" alludes to a convergence of ideals about increasing prosperity and improving the environment, which coincides with the current government's policy aims. During the deliberations on "Beautiful China" centered on "ordinary people's opinion," it became evident that such initiatives would have to rely on technical innovation and should be dissociated from previously supported demographic policies, such as with the long-standing and divisive one-child policy.

The discourses on "green growth" and "green development" have given China the opportunity to mould the agenda-setting processes of world summits to its liking. In Asia, the concept of "green growth" is very popular. The concept originated in the Asia-Pacific area, according to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (UNESCAP, 2016).

The notion of "green development" has been raised to the rank of a key policy target in the preparation of the 13 FYP (2016 to 2020). It was selected as one of five chapter titles to highlight the aims, reforms, and objectives for environmental and climate policy.

The implementation of circular economy policies and projects helped to demonstrate and propagate sustainable development best practices across industries.

Conclusions

National policies that encourage the transition to a CE have the ability to generate economic development while reducing negative environmental externalities. However, without simultaneous investment in regional and global circular value chains, as well as information and innovation sharing, the CE is unlikely to achieve significant scale. Transformation will need collaboration not only at the domestic industry level, but then also throughout global resource chains and material supply chains.

To maximize the effect of CE investments, it will be necessary to align activities with existing sustainable development initiatives and investments, as well as to carefully navigate the possible trade-offs associated with CE approaches. Intergovernmental cooperation will play a key role through bilateral investments, cross-border alliances to promote the growth of regional and international circular value chains, and cooperation on common terms for global trade in secondary materials and CE-related services.

The Paris Agreement and the adoption of the Sustainable Development Goals (SDGs) in 2015 prompted global efforts to foster sustainable and resilient growth that addresses poverty and inequity while protecting finite natural resources and biodiversity. In many instances, achieving the SDGs would make the transition to a CE much easier (Preston et, 2019)

Investments in CE innovations or value chains could be used to strengthen and accelerate current sustainable development projects by foreign financial institutions seeking to promote the adoption of the SDGs and the Paris Agreement. Several Multilateral Development Banks (MDBs) are expanding their circular economy activities by building on existing funds earmarked for these areas and allocating specific funding pools for CE approaches.

The building of resilient international circular value chains would be a key enabler for growing domestic remanufacturing and recycling commitments while also assisting in the fulfilment of global sustainable development process commitments. CE can present opportunities for bilateral investments and partnerships that benefit CE at home and abroad. The European Union, China and Japan have been proactive in finding cross-border cooperation opportunities in the field of CE. Chile, China, India, and South Africa have all received CE missions from the EU. These missions are aimed at communicating the opportunities of transitioning to a CE and assisting European businesses in extending their operations in these countries.

China's President Xi Jinping has announced the Belt and Road Initiative (BRI). It is a collection of ambitious diplomatic and economic policies focused on the growth of infrastructure that connects China's developing borders with Southeast Asia, Central Asia and Europe. Many of China's BRI partners or potential partner countries are in the early stages of modern recycling and waste management development, and some of their BRI infrastructure investment is targeted in this area (Huang et al. 2018). China is also looking for new business models and activities, leveraging its experience in coexistence with industry and the use of eco-industrial complexes. One example is the development of the China-Africa Circular Economy Industrial Zone proposed in South Africa.

The first agreement between the EU and China was the Memorandum of Understanding on Circular Economy Cooperation, signed in July 2018. The Memorandum of Understanding, which lasted for the first five years, aims to coordinate the EU and China on policies to support the transition. To the circular economy to unleash new sources of economic growth and innovation while benefiting people and the environment.

One of the main focus areas of the transaction is to work on plastic waste and packaging waste. Both are big problems for Europe and China. Recent strengthening of the agreement will occur between April 1st and April 3rd, 2019, when the EU delegation visited China to deepen bilateral relations between the EU and China. I did. The discussion was related to accelerating and addressing the challenges of common plastic and packaging waste while supporting the global transition to a resource-efficient circular economy model.

One of the main focus areas for the deal is the treatment of plastic waste, as well as packaging waste. Both are big problems for Europe and China. The creation of a circular economy platform between the EU and China and a short-term action plan would accelerate the transition process, enhance multilateralism, reaffirm a rules-based international order and help address the negative effects of globalization and increase economic integration.

Both sectoral and regional economic growth has been inconsistent. The eastern provinces and manufacturing sectors have contributed the most to the country's economic growth, while economic progress in the western agrarian sectors has been much less pronounced, and in some cases has even stagnated.

We need far more thorough studies and insight into different systemic developments and social practices to assess China's current approach to environmental issues and challenges, as well as the achievements, shortcomings, and dilemmas it faces. These studies are further complicated by the fact that China's environmental governance structure is still evolving and is constantly changing and transitioning as a result of the country's fluid social climate, both domestically and internationally.

The CE's performance in developed countries will be crucial for global efforts to achieve long-term development. Developing countries have become global production hubs and are on their way to being global consumption drivers. Successful integration of the concept of circulation into economic growth and infrastructure development strategies helps meet the needs of growing and urbanizing communities while reducing the use of primary resources, associated emissions and pollution. It is important to invest political and financial resources to broaden the global CE conversation to include developing countries and to support the creation of a comprehensive global CE (Preston et al., 2019). Three levels of action are required:

1. Aligning the CE with developed countries' current policy goals. Decision-makers need assurance that CE approaches are aligned with sustainable development goals, such as driving resilient economic growth and creating jobs for the most disadvantaged people, in order to incorporate CE into high-level industrial strategies and investment planning. In

developing countries, national policymakers should look for synergies between the CE and current national plans, as well as determine the size of the potential in moving to a CE across key sectors of the economy. Donor governments should encourage CE as an industrial growth strategy in developed countries, mobilizing funds to support CE's development and scale-up.

2. Investing in the basics to support developed countries make the transition to the CE. In order to create an enabling environment for testing and launching CE activities, as well as to reduce potential environmental and health risks associated with inadequate waste management, sound management mechanisms, comprehensive policies and cooperation at the national, regional and international levels will be required. Investors should develop joint and mixed financing structures to promote and reduce the risk of early investment in the CE value chain, and national Governments in developed countries should identify priority domestic policy changes in support of CE activities; and, with the assistance of G20 Governments, intergovernmental organizations such as UNIDO and UNEP, should launch a global closed-cycle economy acceleration network to test innovative policy initiatives and build capacity among suppliers from the private sector in developing countries.
3. Supporting a global CE agenda that encourages cooperation and partnership. Trade and collaboration are important ingredients for accelerating CE in emerging economies, and exploiting foreign investment will be essential for capturing opportunities for innovation. Sharing information and learning lessons between those implementing CE and those looking for evidence of successful methods and initiatives is just as important as the financial and material flow. Multilateral development banks need to coordinate their investment in climate change resilience, biodiversity conservation and sustainable development with CE. Developed governments need to recognize early opportunities for "triple-win" cooperation with developing countries to achieve trade, CE, and broader sustainability goals.

As international practices reveal that economic measures remain one of the most effective means of conserving the environment and resources, China's government should promote economic incentive through policies to stimulate enterprises and residents behave under the principles of CE. The current measures, for example pricing reforms, and preferential tax policies should be developed continuously and accordingly. New measures, say environmental taxes, insurance for liability resulting from environmental damage, and environmental labelling, should be explored and be included in legislation to ensure their enactment.

Governments need to continue to support the key technologies needed by CE. This requires governments to accurately identify key technology areas and projects in line with current and long-term economic requirements and to support energy conservation, alternatives, and recycling research. And finally, through R & D investment at both corporate and academic levels, we will enhance the country's ability to innovate on its own.

To increase public awareness and engagement, there should be regular events related to the CE concept, such as TV campaigns, newsletters, achievement exhibitions and seminars. Such initiatives could provide a platform to objectively examine experiences from different parts of the world and different institutions. In addition, enterprises can enhance mutual understanding and friendship through information exchange, laying a solid foundation for further cooperation and promotion of CE.

Also impressive are the improvements in law enforcement and the administrative system within government. He calls for a reform of the justice administration mechanisms and more transparent monitoring and auditing mechanisms. On the other hand, government should form standardized ways of data collection, calculation and submission procedures so as to ensure more accurate assessment of CE's development and should provide local government with quantitative goals for short- and long- term development to enable the progress of CE development to be observed.

Bibliography

1. Anderson, G. (1994). Industry Clustering for Economic Development. *Economic Development Review* 12(2), 26-33.
2. Arup and Ellen MacArthur Foundation (2018), The Circular Economy Opportunity for Urban & Industrial Innovation in China, https://www.ellenmacarthurfoundation.org/assets/downloads/The-circular-economy-opportunity-for-urban-industrial-innovationin-China_19-9-18_1.pdf (accessed 7 Sept. 2020).
3. Asuka-Zhang, S. Transfer of environmentally sound technologies from Japan to China. United States. https://doi.org/10.1016/S0195-9255(99)00028-1
4. Betke, D. (2003). *Environmental Protection Umweltschutz*. In Staiger, B. Friedrich S. & Schütte H.-W. (Eds.), *Das Große China-Lexikon - The Great China Lexicon* (pp. 774-446). Darmstadt: Wissenschaftliche Buchgesellschaft.
5. Boulding, K. E., (1966). The Economics of the Coming Spaceship Earth. Boston University, U.S.
6. *Brazil, China, India, and Beyond.*
7. Cavalieri, R. R., *Letture di diritto cinese*, Venezia, Casa Editrice Cafoscarina, Edizione 2015.
8. Center for climate and energy solutions (2017). Available at https://www.c2es.org/content/internationalemissions/#:~:text=Globally%2C%20the%20primary%20sources%20of,72%20percent%20of%20all%20emissions.
9. Charonis, G.-K., 2012. Degrowth, steady state economics and the circular economy: three distinct yet increasingly converging alternative discourses to economic growth for achieving environmental sustainability and social equity. World Economics Association (WEA) Conferences Available at: http://sustainabilityconference2012.weaconferences.net/papers/degrowth-steady-state-economics-and-the-circulareconomy-three-distinct-yet-increasingly-converging-alternative-discourses-toeconomic-growth-for-achieving-environmental-sustainability-and-soci.
10. Chertow, M. 2007. "Uncovering" industrial symbiosis. *Journal of Industrial Ecology* 11(1): 11–30.
11. *Circular Economy": Rural Development, Natural Resources and Environment Unit*
12. Congress of Environmental and Resource Economists, Kyoto, Japan, 3–7 July 2006.
13. Conticelli, E., Tondelli, S., 2014. Eco-industrial parks and sustainable spatial planning: a possible contradiction? Adm. Sci. 331–349. Available at: http://www.mdpi.com/ 2076-3387/4/3/331 [Accessed November 7, 2020].
14. De Burgh, H. (2003). Skills are not enough: The case for journalism as an academic discipline. *Journalism*, *4*(1), 95–112.
15. De Wit, M., Hoogzaad, J., Ramkumar, S., Friedl, H. and Douma, A. (2018), The Circularity Gap: An analysis of the circular state of the global economy,

https://docs.wixstatic.com/ugd/ad6e59_c497492e589c4307987017f04d7af864.pdf (accessed 4 Dec. 2020).

16. Desrochers, P. (2002). Industrial ecology and the rediscovery of inter-firm recycling linkages: historical evidence and policy implications. *Industrial and Corporate Change*, Volume 11, Issue 5, November 2002, Pages 1031–1057, https://doi.org/10.1093/icc/11.5.1031
17. Du, C.L. and J.H. Cheng (2009). Evaluation on circular economy efficiency about iron and steel industry in China 2003-2006. *Industrial Economics Research* 5, 6-14 (in Chinese).
18. Ekins, P. and Hughes, N. (2017), Resource Efficiency: Potential and Economic Implications, UN Environment Programme (UNEP), https://europa.eu/capacity4dev/unep/documents/resource-efficiency-potential-and-economic-implications (accessed 19 Oct. 2020)
19. Ellen MacArthur Foundation (2018), *The Circular Economy Opportunity for Urban &*
20. Ellen MacArthur Foundation and McKinsey Center for Business and Environment (2015), Growth Within: A Circular Economy Vision for a Competitive Europe, https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/europes-circulareconomy-opportunity (accessed 1 Nov. 2020).
21. Ellen MacArthur Foundation, 2012. Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition. Available at: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf.
22. Ellen MacArthur Foundation, 2017. Circular economy - UK, USA, Europe, Asia & South America. Available at The Ellen MacArthur Foundationhttps://www.ellenmacarthurfoundation.org/ Accessed date: November 2020.
23. Ellen McArthur Foundation, 2020. Circular economy opportunities in China | The Circular Economy Show. Available at https://www.youtube.com/watch?v=orxlvZOB3YI&list=WL&index=9&t=1401s
24. European Commission (2015), Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Closing the loop – An EU action plan for the Circular Economy, 2 December 2015 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015DC0614 (accessed 29 Sept. 2020)
25. Finamore, B. (2016). Tackling Pollution in China's 13th Five Year Plan: Emphasis on Enforcement, NRDC. https://www.nrdc.org/experts/barbara-finamore/tackling-pollution-chinas-13th-five-year-plan-emphasis-enforcement
26. Francesco Di Maio, Peter Carlo Rem, Kees Baldé, Michael Polder, Measuring resource efficiency and circular economy: A market value approach, Resources, Conservation and Recycling, Volume 122, 2017, Pages 163-171, ISSN 0921-3449, https://doi.org/10.1016/j.resconrec.2017.02.009.
27. Gardner, J. (2017), 'Circular economy & decarbonisation: lessons from industry', Hoffmann Centre for Sustainable Resource Economy, 4 September 2017,

https://hoffmanncentre.chathamhouse.org/article/circular-economy-and-decarbonisation-lessons-from-industry/ (accessed 29 Dec. 2020)

28. Geiser, K. 2002. What next in cleaner production technologies? *Industry and Environment* 25(3–4): 75–77
29. Geissdoerfer, M., et al., 2017. The circular economy – a new sustainability paradigm. J. Clean. Prod. 143, 757–768.
30. Geng, Y. and B. Doberstein. 2008. Developing the circular economy in China: Challenges and opportunities for achieving 'leapfrog development'. *International Journal of Sustainable Development &World Ecology* 15(3): 231–239.
31. Geng, Y. and Doberstein, B. (2010). Developing the circular economy in China: Challenges and opportunities for achieving "leapfrog development". *International Journal of Sustainable Development and World Ecology* 15(3), 231-239.
32. *Geng, Y. and R. Cote (2002). Scavengers and decomposers within an eco-industrial park. International Journal of Sustainable Development and World Ecology 9(4), 333-340.*
33. Geng, Y., Fu, J., Sarkis, J. and Xue, B. (2012). Towards a National Circular Economy Indicator System in China: An Evaluation and Critical Analysis. Journal of Cleaner Production 23, 216-224.
34. *Geng, Y., P. Zhang, R.P. Cote and T. Fujita (2009). Assessment of the national ecoindustrial park standard for promoting industrial symbiosis in China. Journal of Industrial Ecology 13(1), 15-26.*
35. Ghisellini, P., Cialani, C., Ulgiati, S., 2016. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. J. Clean. Prod. 114, 11–32. Available at: http://www.sciencedirect.com/science/article/pii/S0959652615012287 [Accessed December 18, 2020].
36. Heilmann, S. (2008). China's political system. Mercator Institute for China Studies (MERICS)
37. Heshmati, A. (2015). A Review of the Circular Economy and its Implementation. *IZA Discussion Paper No. 9611*. https://ssrn.com/abstract=2713032
38. Hicks, C. and R. Dietmar (2007). Improving cleaner production through the application of environmental management tool in China. *Journal of Cleaner Production* 15, 395-408.
39. Hoornweg, D., Bhada-Tata, P. & Kennedy, C. Nature 502, 615–617 (2013).
40. Huang, J., Zhao, R., Huang, T., Wang, X. and Tseng, M., (2018), *Sustainable Municipal Solid Waste Disposal in the Belt and Road Initiative: A Preliminary Proposal for Chengdu City Sustainability,* 10(4): p. 1147, doi: 10.3390/su10041147 (accessed 14 Dec 2020).
41. *Industrial Innovation in China*, Isle of Wight, UK.
42. Jahiel, A. (1998). The Organization of Environmental Protection in China. *The China Quarterly,* (156), 757-787. Retrieved June 28, 2021, from http://www.jstor.org/stable/656124
43. Kalmykova, Y., Sadagopan, M., Rosado, L., 2018. Circular economy – From review of theories and practices to development of implementation tools*, Resources, Conservation and Recycling, Volume* 135, Pages 190-201, https://doi.org/10.1016/j.resconrec.2017.10.034

44. Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, *127*, 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005
45. Kodros, J. K., Wiedinmyer, C., Ford, B., Cucinotta, R., Gan, R., Magzamen, S. and Pierce, J. R. (2016), 'Global burden of mortalitiesdue to chronic exposure to ambient PM2.5 from open combustion of domestic waste', Environmental Research Letters, 11(12): pp. 1–9,doi: 10.1088/1748-9326/11/12/124022 (accessed 17 Nov. 2020).
46. Kostka, G. Barriers to the Implementation of Environmental Policies at the Local Level in China; World Bank Policy Research Working Paper, No. WPS 7016; The World Bank: Washington, DC, USA, 2014.
47. Kuhn, B. (2016). Sustainable Development Discourses in China. *Journal of Sustainable Development; Vol. 9, No. 6*
48. Li, H., W. Bao, C. Xiu, Y. Zhang and H. Xu (2010). Energy conservation and circular economy in China's process industries. *Energy* 35, 4273-4281.
49. Lieder, M., Rashid, A., 2016. Towards circular economy implementation: a comprehensive review in context of manufacturing industry. *J. Clean. Prod.* 115, 36–51.
50. Linder, M., Sarasini, S., van Loon, P., 2017. A metric for quantifying product-Level circularity. J. Ind. Ecol. 21 (3), 545–558. Available at: http://doi.wiley.com/10.1111/jiec.12552 [Accessed January 11, 2021].
51. Liu H., 2016. 刘汉超，2016.04.08。社会主义市场经济 体制下的政府与市场关系。 天津师范大学政治与行政学院。Socialist Market Economy and Government and market relations under this system. School of Politics and Administration, Tianjin Normal University.
52. Liu, L., B. Zhang, and J. Bi. 2012. Reforming China's multi-level environmental governance: Lessons from the 11th Five-Year Plan. *Environmental Science & Policy* 21: 106–111.
53. Liu, Q., Li, H-M., Zuo, X-L., Zhang, F-F., Wang, L. (2009), "A survey and analysis on
54. Ma, X., & Ortolano, L. (2000). Environmental Regulation in China. Institutions, Enforcement and Compliance. *Rowman & Littlefield, Lanham*. http://www.h-net.org/reviews/showrev.cgi?path=25917966636367.
55. Material Economics (2018), The Circular Economy – a Powerful Force for Climate Mitigation, http://materialeconomics.com/publications/the-circular-economy (accessed 3 Nov. 2020).
56. Mathews, J. A., & Tan, H. (2011). Progress toward a circular economy in China: the drivers (and inhibitors) of eco-industrial initiative. *Journal of Industrial Ecology*, *15*(3), 435-457. DOI: 10.1111/j.1530-9290.2011.00332.x
57. Mathews, J.A., & Tan, H. (2016). Circular economy: Lessons from China. *Nature 2016, 531, 440–442.* Doi:10.1038/531440a
58. Mathieux, F. et a., (2017), Critical Raw Materials and the Circular Economy – Background report, Luxembourg: Publications Office of the European Union, doi: 10.2760/378123 (accessed 3 Jan. 2021)
59. McDowall, W., Geng, Y., Huang, B., Barteková, E., Bleischwitz, R., Türkeli, S., Kemp, R., & Doménech T. (2017). Circular Economy Policies in China and Europe*. Journal of Industrial*

Ecology, Special Issue: Exploring the Circular Economy Volume21, Issue3 Pages 651-661. DOI: 10.1111/jiec.12597

60. McKinsey Sustainability (2015). *Europe's circular-economy opportunity.* www.mckinsey.com/business-functions/sustainability/our-insights/europes-circular-economy-opportunity
61. Meadows D., Meadows, D., Randers, J., Behrens, W., (1972). The Limits to growth. *Potomac Associates - Universe Books.*
62. Milios, L. (2018). Advancing to a Circular Economy: three essential ingredients for a comprehensive policy mix. *Sustain Sci 13, 861–878.* DOI: 10.1007/s11625-017-0502-9
63. Mol, A., & Carter, N. (2006). China's environmental governance in transition. *Environmental Politics, 15:2, 149-170.* DOI: 10.1080/09644010600562765
64. Morioka, T., K. Tsunemi, Y. Yamamoto, H. Yabar and N. Yoshida (2005). Eco-efficiency of advanced loop closing systems for vehicles and household appliances in Hyogo Eco-town. *Journal of Industrial Ecology* 9(4), 205-221.
65. Mugge, R. (2018), "Product Design and Consumer Behaviour in a Circular Economy",
66. National Bureau of statistics (2015), 2013 Nian woguo xunhuan jingji fazhan zhishu wei 2013 年我国循环经济发展指数为 (In 2013, the country's circular economy development index was 137.6) http://www.stats.gov.cn/tjsj/zxfb/201503/t20150318_696673.html
67. National People's Congress (2008), Zhonghuo Renmin Gongheguo Xunhuan Jingji Cujin Fa, 中华人民共和国 循环 经济 促进 法 (Law on Promotion of the Circular Economy of the People's Republic of China), Standing Committee of the Fourth Session of the Eleventh National People's Congress, 29 August 2008, Beijing, www.gov.cn/flfg/2008-08/29/content_1084355.htm.
68. OECD (2012), *OECD Environmental Outlook to 2050: The Consequences of Inaction,* OECD Publishing.
69. OECD (2016), Private Sector Engagement for Sustainable Development: Lessons from the DAC, Paris: OECD Publishing, doi: 10.1787/9789264266889-en (accessed 6 Oct. 2020).
70. Olabode, E. (2019). A Review of Circular Economy Development Models in China, Germany and Japan. School of Architecture and Built Environment.
71. P.R.C. Ministry of Environmental Protection (MEP), 2016. Environmental Protection Minister Chen Jining's Press Conference for the Fourth Session of the 12th National People's Congress, MEP, Beijing. http://www.xinhuanet.com/politics/2016lh/zhibo/gov_20160311b/wzsl.htm
72. Palmer, M. 1998. Environmental regulation in the People's Republic of China: The face of domestic law. *The China Quarterly* 156:788–808.
73. PRC. (2008). Circular Economy Promotion Law of the People's Republic of China.
74. Preston, F., Lehne, J., & Wellesley, L. (2019). An Inclusive Circular Economy Priorities for Developing Countries. *Chatham House, The Royal Institute of International Affairs.*
75. public awareness and performance for promoting circular economy in China: a case
76. Ran, R. (2013). Perverse Incentive Structure and Policy Implementation Gap in China's Local Environmental Politics. *Journal of Environmental Policy and Planning,* 15(1). https://doi.org/10.1080/1523908X.2012.752186

77. recommendations", in: *World Bank Technical Assistance Program „China: Promoting a*
78. Ren Yong 任 勇, Wu Yu-Ping 吴玉萍 (2005), Zhongguo xunhuan jingji neihan jiyouguan lilun wenti tantao 中国 循环 经济 内涵 及 有关 理论 问题 探讨, (Discussion on connotation and related theoretical issues of the concept of Chinese circular economy) Population, Resources and Environment, 15, 4, pp. 131-136.*Ren, Y. (2007). The circular economy in China. Journal Mater Cycles Waste Management 9, 121-129.*
79. Roser M., 2020. *The world's energy problem*, Our World Data. Available at https://ourworldindata.org/worldsenergyproblem#:~:text=The%20world%20lacks%20safe%2C%20low,access%20and%20greenhouse%20gas%20emissions. (Accessed January 2021)
80. Sauvé, S., Bernard, S., Sloan, P., 2016. Environmental sciences: sustainable development and circular economy: alternative concepts for trans-disciplinary research. Environ. Dev. 17, 48–56.
81. Shen, K. 2011. Local and central government relations: Impulsive investment and sustainable development. In *Green China: Chinese insights on environment and development*, edited by J. Keeley and Y. Zheng. London: International Institute for Environment and Development.
82. Shi, H., S.Z. Peng, Y. Liu and P. Zhong (2008). Barriers to the implementation of cleaner production in Chinese SMEs: government, industry and expert stakeholders' perspectives. *Journal of Cleaner Production* 16, 842-852.
83. Shi, L., Xing, L., Bi, J., Zhang, B. (2006), *Circular economy: A new development*
84. Stalley, P. (2015). China. In K. Backstrand, & E. Lövbrand (Eds.), *Research Handbook on Climate Governance* (pp. 201-212). Cheltenham (UK), Northhamption (USA): Edward Elgar.
85. Standing Committee of the National People's Congress (2008). "Circular Economy Promotion Law of the People's Republic of China". http://www.lawinfochina.com/display.aspx?id=7025&lib=law
86. State Council of the People's Republic of China (2013), guowuyuan guanyu yinfa xunhuan jingji fazhan zhanlue jijinqi xingdong jihua de tongzhi 国务院 关于 印发 循环 经济 发展 战略 及 近期 行动 计划 的 通知, (Communication of the State Council concerning the development strategy of the circular economy and the action plan), State Council of the People's Republic of China, Beijing , www.gov.cn/zwgk/2013-02/05/content_2327562.htm.
87. State Council (2005), Guowu youguan jiakuai fazhan xunhuan jingji de ruogan yijian， 国务 有关 加快 发展 循环 经济 的 若干 意见, (Some opinions of the Council of State on accelerating the development of the circular economy), State Council of the Republic Chinese People's, Beijing, www.gov.cn/gongbao/content/2005/content 64318.htm.
88. *strategy for sustainable development in China*, lavoro presentato al Third World
89. study from Tianjin", *Journal of Cleaner Production*, 17, pp.265–270.
90. Su, B., A. Heshmati, Y. Geng and X. Yu (2013). A review of the circular economy in China: moving from rhetoric to implementation. *Journal of Cleaner Production* 42, 215-227.
91. *Sustainability*, 10, pp.1 – 4.
92. Taylor, L. (2020, October 14). What is circular economy and why do we need to go circular? *Planet Ark Environmental Foundation*. Available at

https://planetark.org/newsroom/news/what-is-the-linear-economy-and-why-do-we-need-to-go-circular

93. Taylor, R.P. (2008), *Financing Energy Efficiency: Lessons from Brazil, China, India,*
94. The World Bank (2009), "Developing a circular economy in China: highlights and
95. The World Bank. (2020, April 23). The Work Bank in China. https://www.worldbank.org/en/country/china/overview
96. Thierot, H., Sawyer, D. (2015). Development of Eco-Efficient Industrial Parks in China: A review. International Institute for Sustainable Development.
97. Torney, D., Yan, B. (2016). Confronting The Climate Challenge: Convergence and Divergence between the EU and China. China, the European Union, and the International Politics of Global Governance.
98. Turner, R., Pearce, D., (1990). Economics of Natural Resources and the Environment. *Johns Hopkins University Press.*
99. UNEP (2017), Consuming Differently, Consuming Sustainably: Behavioural Insights for Policymaking, http://www.ideas42.org/wp-content/uploads/2017/11/UNEP_consuming_sustainably_Behavioral_Insights.pdf (accessed 11 Oct. 2020).
100. United Nations Development Programme (UNDP). (2015). *China, the Millennium Development Goals and the Post-2015 Development Agenda*. New York: UNDP, February 2015.
101. United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019: Highlights (ST/ESA/SER.A/423).
102. United Nations, Sustainable Development Goals, 2015. Available at https://sdgs.un.org/goals
103. Van Berkel, R., T. Fujita, S. Hashimoto, and Y. Geng (2009). Industrial and urban symbiosis in Japan: analysis of the eco-town. *Journal of Environmental Management* 90, 1544-1556.
104. Wang, J. and M. Wang. 2011. Environmental rule of law in China: Why the system isn't working. In *Chinese insights on environment and development*, edited by Y. Zheng and J. Keeley. London: International Institute for Environment and Development.
105. Wang, Y.J. and H.H. Liu (2007). Green barriers from the standpoint of sustainable development. *Journal of Economic Policy Reform* 10(3), 233-240.
106. Wanxin Li & Paul Higgins (2013) Controlling Local Environmental Performance: an analysis of three national environmental management programs in the context of regional disparities in China, Journal of Contemporary China, 22:81, 409-427, DOI: 10.1080/10670564.2012.748961
107. WBCSD, (2010). *Vision 2050: The new agenda for business*, Chapter II. WBCSD Publishing
108. WBCSD, 2017. Our Approach. *World Business Council for Sustainable Development*. Available at http://www.wbcsd.org/Overview/Ourapproach.

109. Weng, X., Z. Dong, Q. Wu, and Y. Qin. 2015. China's path to a green economy: Decoding China's green economy concepts and policies. London: International Institute for Environment and Development.

110. World Bank Group, R.P.Taylor et al., (2008), *Financing Energy Efficiency: Lessons from*

111. WRAP (2015), *Economic Growth Potential of More Circular Economies*, http://www.wrap.org.uk/sites/files/wrap/Economic%20growth%20potential%20of_more%20circular%20economies.pdf (accessed 3 Jan. 2021).

112. Xie, L. (2011). China's environmental activism in the age of globalization. *Asian Politics and Policy* 3(2), 207-224.

113. Xu, Y. 2014. Mao Zedong and the comprehensive utilization of resources. *Contemporary China History Studies* 21(3): 59–66.

114. Ye, J., & Fues, T. (2014), A Strong Voice for Global Sustainable Development: How China Can Play a Leading Role in the Post-2015 Agenda. *Briefing Paper of the German Development Institute, 2.*

115. Ying L., Cheng, H., Beeton, R., Sigler, T., & Halog, A. (2016). Sustainability from a Chinese Cultural Perspective: The Implications of Harmonious Development in Environmental Management. *Environment, Development and Sustainability, 18*(3), 679-696. https://doi.org/10.1007/s10668-015-9671-9

116. Yong, R. (2007). The circular economy in China. *J Mater Cycles Waste Manag* **9,** 121–129. DOI 10.1007/s10163-007-0183-z

117. Yu, C., G. P. Dijkema, and M. Jong. 2015. What makes ecotransformation of industrial parks take off in China? *Journal of Industrial Ecology* 19(3): 441–456.

118. Yu, F., Han, F. & Cui, Z. J. Clean. Prod. 87, 339–347 (2015).

119. Yuan, Z., Bi, J., Moriguichi, Y., 2008. The circular economy: a new development strategy in China. J. Ind. Ecol. 10 (1–2), 4–8. Available at: http://doi.wiley.com/10.1162/108819806775545321 [Accessed November 6, 2020].

120. Zhang L., Yuan, Z.W., Bi, J. Zhang, B. and Liu, B.B. (2010). Eco-industrial Parks: National Pilot Practices in China. *Journal of Cleaner Production* 18, 504-509.

121. Zhang, B. (2016). Supervise Chinese environment policy. *Nature, 534, p. 179.* DOI: 10.1038/534179d

122. Zhao, H., X. Zhu, and Y. Qi. 2016. Fostering local entrepreneurship through regional environmental pilot schemes: The low-carbon development path ofChina. *China: An International Journal* 14(3):107–130.

123. Zheng, Y. 2011. China's environment and development challenge. In *Chinese insights on environment and development*, edited by Y. Zheng and J. Keeley. London: International Institute for Environment and Development.

124. Zhou, H. (2006). Circular economy in China and recommendations. *Ecological Economy* 2, 1012-1114

125. Zhu, D.J. (2005). Circular Economy: New Economy for 21 Century. *Empirical Reference* 8, 28-30. (In Chinese)

126. Zhu, D.J. and Qiu, S.F. (2007). Analytical Tool for Urban Circular Economy Planning and its Preliminary Application: A case of Shanghai. *Urban Ecological Planning* 31(3), 64-70. (In Chinese)
127. Zhu, J., Fan, C., Shi, H., & Shi, L. (2018). Efforts for a Circular Economy in China: A Comprehensive Review of Policies. *J. Ind. Ecol., 23, 110–118.* DOI: 10.1111/jiec.12754
128. Zhu, J., Fan, C., Shi, H., & Shi, L. (2019). Efforts for a Circular Economy in China: A Comprehensive Review of Policies. *J. Ind. Ecol., 23, 110–118.* DOI: 10.1111/jiec.12754

Webinars and video-interviews

1. Disruptive Innovation Festival – DIF, Comparing Circular Economy Policies Across Europe and China (2018). Available at https://www.thinkdif.co/
2. Ellen MacArthur Foundation, 2018 Summit. How is China Adopting & Applying Circular Economy? Available at https://www.thinkdif.co/
3. Ellen MacArthur Foundation, July 2020. Circular economy opportunities in China | The Circular Economy Show Episode 8. Available at https://www.ellenmacarthurfoundation.org/our-work/activities/the-circular-economy-show (accessed July 2020)
4. ENRICH in China. February 27th, 2019. China's Path to Industrialized Modernity.
5. IEA- International Energy Agency, China's Emissions Trading Scheme (2020). Available at https://www.iea.org/reports/chinas-emissions-trading-scheme
6. *Innovation for a Green New Era*, The China Council for International Cooperation on Environment and Development, 1-3 November 2018.
7. TEDxYouth@EEB3. 13 February 2018. *The Circular Economy: A Simple Explanation*. Available at https://www.ted.com/talks/cillian_lohan_the_circular_economy_a_simple_explanation