JUST2CE

A Just Transition to Circular Economy

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

CHAPTER 23

Circular Economy transition in China ed India

Chapter 23. Circular Economy transition in China ed India

Antonio Thomas

Abstract

China and India are the world's two most populous countries, characterized by various similarities, such as an export-driven economy. Nevertheless, they seem to have approached the topic of circular economy and sustainability more broadly somewhat differently.
The investigations conducted by Chinese and Indian researchers show a different approach toward the topic of circular economy. For China, government action appears to be very incisive, maybe in the attempt to maintain world leadership as the leading exporting country. For India, on the other hand, the country's difficulty in countering the rapid population growth that has occurred in the last decades and the corresponding growth in waste, as well as tackling the environmental and social impacts, emerges. Some remarks can be derived from this comparison, which in some way is still conditioned by the presence of a different amount of resources to be invested in this direction.

Keywords: circular economy, sustainability, municipal solid waste, 3R principles, eco-industrial parks.

The paper aims to underline how two large countries with many similarities demonstrate different attention toward circular economy and sustainability in general. A significant issue by virtue of their high impact on the environmental sustainability of the entire planet.

A bit odd phrasing, and definitely too vague

23.1 Introduction

The circular economy is gradually changing how we manage and use the resources and materials needed to carry out human and industrial activities. The most significant change is probably, at the cultural level related to an increasingly pervasive diffusion, in the international community, of the logic underlying sustainable development. Pivotal to this approach is the need to re-use, repair or remanufacture products that are commonly used in production processes, with a potential 48 percent reduction in greenhouse emissions by 2030 (EllenMacArthurFoundation, 2015). More and more countries and companies, therefore, have decided to change

production methods to adopt circular economy practices; starting with the use of materials and production processes that can facilitate the recovery of used materials.

Not by chance, the concept of circular economy (hereafter CE) has recently gained momentum in the political, scientific, and economic debate. As a result, organizations and scholars have established different sets of principles for its adoption, also widening the perspectives linked to the implementation of CE pillars to those technical, geopolitical and social factors able to assure a transition to the CE that also becomes responsible, inclusive and socially fair for people living in heterogeneous contexts characterized by specific different features.

The attention paid by the European Union (EU) in this regard is certainly to be judged as a pathfinder. In 2020, as part of the *European Green deal*, the European Commission adopted a set of proposals to make the EU's climate, energy, transport, and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990. This target includes specific regulations, such as new rules on packaging, the abolition of planned obsolescence of products, and the 'right to repair, to extend the life cycle of products, minimizing waste, and recycling materials to make them participate in other production cycles. The latter goals aspire to combine sustainability with an increase in the competitiveness of EU countries and employment dynamics.

Of course, the EU is not the only significant area of the world that is quickly heads toward the CE path. International objectives for achieving a global CE are enclosed in the United Nations' *Sustainable Development Goals* (SDGs) signed by all 191 UN Member States. Specifically, Global Goal 12 aspires to ensure sustainable consumption and production patterns. It includes targets that intend to achieve more efficient use of resources (target 12.2) and reduce waste generation through prevention, reduction, recycling, and re-use (target 12.5).

Less known could be the directions in which other areas of the world are moving. In this regard, this chapter aims to provide an overview of the state of the art of EC-related practices adopted in China and India. The aim is to show and discuss the main policies that these two great nations have implemented in the direction of sustainable development.

The salient characteristic of China and India is that their fast-growing economies are expected to dominate the global economy by 2050. Geographically, these two countries cover a combined area of 12,857,460 km^2, about 8.7% of the world's land surface, with an estimated total population of about 2,86 billion, 35.6% of the global population. Economically, they are members of the G20, with a combined total GDP of around US$ 20,648 trillion (21.9% of global GDP), and a GDP pro-capita of US$ (PPA) 21,358 and 8,358, respectively (FMI database).

The next two sections describe the development and the key features of CE in China and India. The last section offers some conclusive remarks.

23.2The development of circular economy in China

23.2.1 The framework

People's Republic of China has a long and established tradition of policies related to the CE, as in this country, CE is not simply regarded as an incrementally improved environment management policy, but it has been introduced as a binding paradigm supporting the transition of the country's economic system toward a more sustainable economic structure. Consistently, the CE embodies a broad series of environmental efficiency-oriented initiatives concerning the whole material flow at all production, distribution, and consumption (Su et al., 2013). In doing so,

the CE traditionally covers more areas, aside from resources and waste problems, concerning renewable energy systems and energy saving, land management and soil protection, and water resource management (Geng and Doberstein, 2008). Consistently with these assumptions, in this country, CE is usually meant as "a generic term for the reducing, re-using and recycling activities conducted in the process of production, circulation, and consumption", reflecting the linkage with the "3R framework" (reduce, re-use, recycle) (Liu et al., 2017).[38]

Not surprisingly, policies regarding a comprehensive resource utilization were first introduced in the 1950s, hoping to obtain more products from the same resource (Zhu et al., 2010). In the 1970s, the attention to sustainability issues significantly increased because of the effects of growing pollution and the enormous demand for resources caused by the rapid industrialization processes involving the country. Until the 1990s, however, the main reason that prompted the interest in the EC principles was the lack of resources that could feed an economy with an average growth of 10.6% per annum during the last 30 years. The search for more efficient methods of using resources or for their re-use has, therefore, become a fundamental goal for the largest worldly exporter and energy user (21.3% of the total in the world).

The rapid growth of the economy has also caused extremely serious problems in the country, such as air pollution, deforestation, water depletion, desertification, land degradation, loss of biodiversity. Consequently, China's politicians have been encouraged to consider the EC as a pathway to follow in order to reduce the exponential increase of greenhouse emissions and environmental degradation, ensure human health, and to contrast the other social problems due to the huge population, such as pollution by urban and industrial waste.

However, only from 2002, the concept of CE formally found its introduction in China, when the Government accepted the idea of a new development strategy entrusted to an entity named *State Environmental Protection Administration*. In that year central authorities also enacted the *Cleaner Production Promotion Act*.

In the meantime, in 2004, China became the world's largest waste generator overtaking the USA. This immense amount of industrial solid waste produced by the Country represents one-quarter of the world total (Geng and Doberstein, 2008). Moreover, China also consumes approximately 2.5 kilograms of raw material to produce $1 GDP, while OECD countries only require 0.54 kilograms on average (Mathews and Tan, 2016). Due to this gap, in the same year the *Chinese State Council National* appointed the *National Development and Reform Commission* instead of the mentioned *State Environmental Protection Administration* to take over the duty for promoting and implementing the CE in the country. Since then, Chinese policy makers proposed a Five-Year Plan specifically aimed at enforcing and promoting the CE. The activities carried out under this new framework can be addressed into three levels (called *circles*) simultaneously covering the areas of production, consumption, and waste management.

[38] The Chinese approach toward CE is wider than that proposed both by the *EllenMacArthurFoundation*, and the EU. The first considers the CE an alternative form of economic model that aims at decoupling global economic development from finite resource consumption (2015: 20): "one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles". The EU concept of CE focuses on the value of products and resources, and aims at promoting the minimization of their use and waste: "the value of products and materials is maintained for as long as possible; waste and resource use are minimized, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value" (EC, 2015). So, while the EU's approach focuses more narrowly on waste and resources and opportunities for business, the Chinese concept of CE also incorporates pollution and other issues, as it is framed as a response to the environmental challenges created by rapid growth and industrialization (McDowall et al., 2017).

The first circle refers to the corporate or micro level. It chiefly involves the design of manufacturing plants, concerning issues such as cleaner production, *environmental management systems*, and product recycling schemes. To date, the most significant and successful activity at the micro-level of the CE has been cleaner production. Demonstration projects have been implemented in twenty-four Chinese provinces, involving a diverse range of industrial sectors, including chemical, construction materials, petrochemicals, pharmaceuticals, machine manufacturing, mining, textiles, power plants, metallurgical industry, light industry, transportation, and electronic industry (Geng and Doberstein, 2008).

The second circle is the inter-firm or meso level. It was created with the purpose to capitalise on the trading of industrial by products such as heat energy, wastewater, and manufacturing wastes, and is based on the promotion of eco-agricultural systems, waste trade markets, and especially *eco-industrial parks* (EIP), where companies valorise the economies of agglomeration between plants that interchange products and materials, reducing waste.[39] A typical Chinese EIP consists of an industrial production area, a scientific research area, a residential area, and a business and service area, where they all share the benefits of the CE, since they are connected with one another. Thus, the Chinese method of planning EIPs, which includes production and residential areas, emphasizes the establishment of integrated material, water, and energy management systems. This integrated approach encourages the creation and maintenance of eco-industrial networks among companies placed in these areas (Bleischwitzet al., 2022).[40]

In the third circle, also identified the macro-level or social level, the CE stimulates both sustainable production, and consumption activities through the development of eco-cities and eco-provinces that attempt to create a recycling-oriented and pollution prevention society (Geng et al., 2011). The CE cities and provinces are involved along four directions: i) the industrial system, ii) the infrastructure, iii) the cultural setting, and iv) social consumption. Chinese institutions selected the Guiyang City and Liaoning Province as China's first pilot experimentation of macro-level CE.

Within this framework, in January 2009 Chinese Government implemented the *Circular Economy Promotion Law*, indicating the involvement of the fundamental CE pillars in its economic development plans. This law was the world's first national regulation supporting CE at all levels of society. This law claimed that economic growth must pursue sustainable ways at every level of state policies. Following this law, new industrial policies created by the Government must meet the criteria for promoting a circular economy based on the three mentioned “R” principles: reduction, re-use, and recycling of activities in the production, circulation, and consumption of products (Li and Lin, 2016). Simultaneously, other regulations stimulate companies to implement management systems reducing resource usage and waste generation while improving resource recovery and recycling (Mathews and Tan, 2011). The key industries individuate for applying the principles of the EC concern high environmental impact sectors,

[39] All the companies belong to an EIP share common infrastructure and services and trade industrial by-products, such as heat, energy, wastewater, and manufacturing wastes for the reduction of use of new raw materials. To form an interdependent ecological industrial system, wastes or by-products of one level of production tend to become raw material or inputs for other productive cycles by the process of waste exchange, clean production, and other measures to achieve the closed-circuit circulation of materials and the multi-level use of energy (Su et al., 2013). As a result, an EIP is expected to maximize use of materials and energy and minimize release of wastes.

[40] EIPs are usually categorized as: i) *integrated* (i.e., with entities/operations from several industrial sectors); (ii) *sectoral* (i.e., with a dominant industrial sector); and (iii) *venous* (i.e., the dominant industrial sector is waste reuse and recycle) (Lyu et al., 2022).

such as steel, nonferrous metals, coal, electricity, chemicals, building materials, light industry, papermaking, textile, machinery manufacturing, agriculture (forestry), processing and utilization base of renewable resources.

At the societal level, a rapid increase in the number of pilot projects concerning the CE and their scope is in progress. To date, the *National Development and Reform Commission* has initiated two batches of national pilot projects, including participation by 109 enterprises, 33 industrial parks, seven provinces, and nineteen cities. Even large towns such as Shanghai, Yangzhou, Guiyang, and Hangzhou have plans for establishing an eco-city. Eco-cities and eco-provinces aspire to make the whole inherent area a CE; that is zones where recycled renewable energy produces close to zero carbon waste power for each existing activity.

23.2.2 Toward the future

The *Circular Economy Development Strategies Action Plan* created in 2013 has further embedded the idea of CE into Chinese legislation with clearly defined goals, such as the re-using 72% of industrial solid waste, a modern system for recovering at least 70% of waste products, raising energy productivity by 18.5%, increasing water productivity by 43%, and re-using 70% of some minerals that are heavy pollutants (Mathews and Tan, 2016). The 13th five-year plan (2016-2020) has also introduced specific measures devoted in recovering polluted areas. Moreover, it has favoured the creation of various institutions to support micro-level CE initiatives and the creation of 20 EIPs (Mathews et al., 2018).

The most recent 14th five-year plan, covering the timeframe 2021-25, aspires to develop the CE focusing on initiatives such as promoting recycling, remanufacturing, green product design, and renewable resources. This plan should impact all manufacturers doing business in China, but especially those using resources for production and creating waste (Bleischwitz et al., 2022).

The targets fixed by 2025 include (Yuan et al., 2020):

- improving resource productivity by 20%, and energy and water consumption per unit of GDP lower by 13.5% and 16%, respectively, compared to 2020 levels,
- reaching a utilization rate of 60% for bulk solid waste and 60% for construction waste,
- re-utilizing sixty million tons of wastepaper and 320 million tons of scrap steel,
- producing twenty million tons of recycled nonferrous metals,
- increasing the output value of the resource recycling industry to US$773 billion.

Additionally, this last five-year plan sets further interventions China should undertake to achieve higher compliance with the CE principles. The new guidelines include (Bleischwitz et al., 2022):

- promoting the green design of products,
- strengthening clean production by accelerating innovations and upgrading,
- enforcing the R&D concerning the utilization of wastes and reusable materials in industries such as ecological restoration, green building materials, and transportation engineering,
- promoting the co-processing of urban waste,
- improving the recycling network of waste materials,
- increasing the level of processing and utilization of renewable resources,
- encouraging the recycling and utilization of agricultural and forestry waste.

The final purpose of these interventions is to reach neutrality in greenhouse gas emissions in 2060. The goal is not easy to pursue, considering that China emitted 27% of the world's greenhouse gases in 2021 and has more installed coal capacity than the rest of the world combined.

Regardless of the real ability to reach these targets, it may be said that the era of relying on large amounts of resource consumption to drive economic growth is going to end as, currently, environmental protection and improvement are listed among the highest priorities on China's development agenda. This situation, unprecedented in Chinese history, represent an epochal change in the economic history of this country (Pesce et al., 2020; Bleischwitz et al., 2022).

Likewise, other Western countries, such as the USA and Germany, the Chinese Government tend to support these initiatives through preferential industrial recruitment and financial policies, such as land subsidies and tax incentives. Even the most adopted tool to measure CE performances – the *Material Flow Analysis* - [41] derives from western countries, recalling the EU's index (Geng et al., 2011). Anyway, the most imitated example of environmental and sustainability policies was the Japanese law for *Effective Utilization of Recyclables* implementing CE since 1991 (Qi et al., 2016). That is as, since 2000, Japan has showed the ambition to establish CE in the whole country, in order to join production, consumption, and waste management into a unique "recycle-oriented society".

As explained, *National Development and Reform Commission* is the leading institution for the policies concerning the EC. It is responsible for organizing and coordinating the academia, central government departments, industrial associations, and local governments during the study and design of the Chinese CE indicator system. Furthermore, the *Commission* regularly evaluates the performances of lower-level governments respect on the fixed targets, assuring that the policies planned by higher-level institutions are rightly implemented at the local level.

23.2.3 Perspectives and limits

Many scholars (e.g., Qi et al., 2016; McDowall et al., 2017) believe that the implementation of CE in China is gaining various benefits, in terms of economic, environmental, and social welfare. In addition to a contributing to unemployment problems, these benefits concern the quality of life for citizens, proper use of resources, and the environment, stimulating social justice at a higher level, preventing environmental poverty, and narrowing the income gap between population. The most important transformation, however, is related to the image of the country as a whole and of Chinese companies. In fact, citizens and consumers of Western countries have recently starting to modify their minds on the quality of the products that come from China and on the consequences for the environment of the productions made in that country. Until now, the image of low-quality productions with a high environmental impact has prevailed.

[41] As known, the *Material Flow Analysis* is a quantitative method of measuring the flow of natural resources and material through various scales of economy, which can range from whole cities to single rivers. It consists of methodically organized indices, where it then uses mass balancing to analyse the relationships between human activities, material flows and environmental degradation. This method can be altered to examine anything from all the energy flowing through an economy to single chemical element, such as carbon. The indicator system is particularly valid in identifying the inefficient use of energy, natural resources and materials, as well as how material flow shifts affect the countries' economy and environment.

Nevertheless, China still has a long way to go to improve its credibility and reputation. The lack of specific and unanimously accepted indicators does not allow a precise calculation of the results obtained by China and its companies in terms of CE to be shown to Western countries more attentive to these issues.

However, an undoubtable aspect is that, with a framework of 280 measures related to sustainability, China has a long history of resource-oriented policies and implemented production-oriented policies. Hence, although the policies have quickly expanded only after the year 2000, the country can be considered a pioneer in the CE (Zhu et al., 2018). Moreover, the CE as interpreted in China differs from the concept in the EU through a broader environmental approach, e.g., by addressing air pollution and water and emphasizing less waste hierarchy[42]. Subsequently, China's policies toward the CE became more comprehensive over time, with a broad engagement of government agencies, an extensive and progressive coverage of recycling opportunities, production initiatives across multiple scales, and use of different policy instruments. Besides the initiative-taking efforts by the state actors, policymakers have largely benefited from knowledge from international experiences with a process of adoption and assimilation (Mohajan, 2021). They learned to innovative ideas and practices internationally, and integrated them into policies in a manner consistent with the local features, even if the internal context of China is too large to be considered as homogeneous (Geng and Doberstein, 2008).

This study also reminds that China's policymaking efforts toward the CE have been an enduring, incremental one, leading to a comprehensive set of related policies and state actors. The progress benefited from a top-down approach and integration of international and academic knowledge (Geng and Doberstein, 2008; Mathews and Tan, 2016). The objectives of the CE do not directly conflict with the country's ambitions to pursue a high level of economic development and industrialization. Conversely, CE addresses key issues China has been facing in its rapid growth, such as resource scarcity, low productivity, and air and water pollution. This positive picture of great dynamism nevertheless contains limits and barriers that slow down the path toward the full application of the CE principles and hinder the achievement of the targets set by the programs.

A first relevant limitation is that the current policy framework is too stressed on the means toward the CE and not enough on the ends and prospects of the CE itself. Most of the policies concern increasing available resource flows and resource productivity without attending to the ends of a sustainable scale of stocks of product and service provision for consumption and final needs. That is, little attention is paid to identifying an optimal level of consumption that can be judged sustainable over time. The related risk is to assume that production volumes can expand infinitely (Zhu et al., 2019; Pesce et al., 2020).

A second barrier is that the most of incentive-based measures is not market-based but company-based. In doing so, companies tend to internalize externalities increasing their competitiveness but without transferring the benefit an upper efficiency to the market. This situation also encourages companies to obtain policy incentives through lobbying that affects the policymaking process regarding the design of incentives themselves (Liu and Côté, 2017; Zhu et al., 2019). Thus, it would be appropriate for companies to be more focused to consumer and market demands, instead of directing their attention to the search for incentives, as incentives do not necessarily correspond to the most appropriate market requests.

[42] *Waste hierarchy* is a tool for the evaluation of processes protecting the environment alongside resource and energy consumption, from most favourable to least favourable actions according a priority based on sustainability.

A third limitations regards the Chinese legal system, that currently is quite fragmented and lacks a unified platform for promoting the CE. For example, some of China's current tax regulations discourage businesses and the public from re-using or recycling resources, while the extremely low resource taxation system disincentives material recycling (Mohajan, 2021; Bleischwitz et al., 2022). So, to fill the gap that does not allow a unitary view of the whole policies and strategies to reach the target, the legislation should also be improved.

A fourth trouble emerging in this country is the weak applying of the regulations assuring the respect of the rules. The linkage between noncompliance with a regulation and the punishment for noncompliance that can be judged as inadequate. That is, because injured parties are not adequately compensated, and some environmental crimes receive administrative instead of criminal punishment (Su et al., 2013).

A further barrier to the diffusion of CE in China concerns the low presence of state-of-the-art environmental technologies, due to the inadequateness of technical capabilities and financial resources (Mathews and Tan, 2011). Systematic efforts by institutions to try to close these gaps are still lacking.

23.3 The complex transition of India toward of circular economy

23.3.1 Background

India is a nation known to have many contradictions. Having recently become the most populated country in the world, it is also characterized by wide inequalities and types of production carried out mainly by a myriad of small and very small enterprises with methods that are not up to date on the technological side and without much respect for the preservation of resources or the environment in general. These circumstances result in heavy repercussions on the endogenous context, both on the environmental and social side, but also from the exogenous side, penalising the image and reputation of Indian companies and of the country as whole (Ghosh, 2020; Ardra and Barua, 2022). It is clear, therefore, that the adoption of CE criteria holds considerable importance for its economy and the world economy. At present, however, although multiple directives have been issued in this regard, there is a lack of a comprehensive framework that compels or incentivizes companies to pursue sustainability principles (Utkarsh and Ahluwalia, 2018. Ghosh et al., 2021).

23.3.2 The municipal solid waste

The reasons concerning the previous brief description are many and they will be explained shortly. First, it should be mentioned that, according to local scholars (Rehman et al., 2016; Sharma et al., 2021; Lahane and Kant, 2022), India's main problem concerns *municipal solid waste* (henceforth MSW)[43] India currently produces 62 million tons of solid waste per day. Based on changing consumption patterns and rapid economic growth, this volume will reach 165 million tons by 2030 and 436 million tons by 2050.

[43] MSW is here considered according to the definition of *The World Bank* (World Development Indicators, 2012) as: "non-hazardous waste generated in households, commercial and business establishments, institutions, and non-hazardous industrial process wastes, agricultural wastes and sewage sludge".

The generation of 62 million tons is further divided into hazardous waste, including biomedical waste (about 4.5 million tons), plastic waste (about 3 million tons), and electronic waste (3.2 million tons). Of 62 million tons of solid waste, only 20% is recycled. The most significant recycling component concerns electronic waste. About 50 percent of it is processed to extract valuable metals such as gold, silver, platinum, and other expensive ones that are then resold (Goyal et al., 2018; Kumar and Agrawal, 2020). As in other developing economies, the most common method of disposing of the remaining 80 percent of MSW involves storing it in open landfills, in most cases illegally, thus, spilling pollutants into soil and water. As an alternative to landfill, wastes are incinerated, releasing toxic gases and pollutants into the atmosphere. Both prevailing methods, therefore, severely affect human health and sustainability. Waste proliferation is believed to be connected to increasing levels of debilitating diseases, neurological disorders, respiratory problems, and birth deformities among Indian citizens (Mutz, 2015).

Although this sector is regulated by various legislations enacted by the *Ministry of Environment, Forestry, and Climate Change*, in cooperation with the *Central Pollution Control Commission*, state governments, and municipalities, waste management continues to be carried out primarily as a fragmented and unorganized activity, employing 39 million workers. This number represents nearly 3 percent of the population. People working in this sector usually lack adequate training, safety measures, and awareness of the risks they face. Not surprisingly, they have a life expectancy of 45 years and spend 30 percent of their income on medicine (Fiksel et al., 2021).

The remaining 80% of MSW is not recycled mainly due to insufficient municipal services. In most cities, the dustbins installed for waste collection are not cleaned regularly, resulting in people dumping household waste along roadsides, street corners, and in vacant lots, thus creating unauthorized, unhygienic, and unsustainable local landfills (Kumar and Agrawal, 2020).

In rural areas, including about 377 million people, agricultural wastes, including crop and animal residues, are often burnt in the field, or used as traditional household fuels. These practices have resulted in severe air, soil and water pollution, creating health problems for workers and nearby households. Currently, recycling and composting programs are unable to keep pace with the growth of waste, although, from few years, some startup companies and NGOs are introducing new solutions ranging from high-tech waste processing to improve training and support for waste picker communities.

In addition to the constant rise in population, the fast increase in municipal waste in India is primarily due to the diffusion of consumerism. In turn, consumerism has been fostered by the quick improvement of inhabitants' average income and to the growth of middle class, as well as from the higher number of workers with purchasing power, from the interest of foreign retailers to collect market share, and relevant change in consumers' aspirations to enlarge the set tangible products they possess (Utkarsh and Ahluwalia, 2018; Ardra and Barua, 2022). However, while companies firstly aim to capitalize their profit avoiding investments in sustainability that do not ensure an improvement in the economic-financial balance, the need for waste management practices is left to the low effectiveness measures of Government, local entities, and citizens.

To tackle the consequences of waste produced by consumerism, since 1991 the Indian Government has launched the so-called "launched the eco-labeling 'Ecomark' scheme, to increase consumer awareness, for easy identification of environment-friendly products" (Yaduvanshi et al., 2017: 5). This, many companies have included green activities in their business and products. Adopting green consumerism is a promising approach to reducing environmental impacts (Yaduvanshi et al., 2017; Lahane and Kant, 2022). In general, however, a significant proportion of the population still has a high level of poverty and is unwilling to pay any additional costs to have

more sustainable goods/services (value for money), especially in the emerging rural markets (Singhal et al., 2019; Nudurupati et al., 2022).

A second well-founded reason for the steep increase in MSW is the heavy urbanization, as the percentage of people living in urban areas has grown to 37.7% in 2015, as compared to 17.29% in 1950. Anyway, big cities are able to "collect around 70 to 90% of MSW generated, in comparison to smaller cities and towns that gather less than 50% of waste generated" (Yaduvanshi et al., 2017: 3).

A third motive concerns citizens' lack of awareness of environmental and sustainability issues which does not solicitate companies to adequate their productive systems. Not by chance, researchers (Fiksel et al., 2021; Nudurupati et al., 2022) observe that the adoption of EC in Indian companies still is an infancy phase, despite various government-sponsored initiatives and adherence to international targets. Even so, the investigations show a moderate awareness of CE, but which does not correspond to actual consumption choices. For instance, the *Green Living Survey* conducted in 2014 found that most Indian consumers are familiar with green products, have confidence that green products are better for the environment, and feel that bio-based ingredient enhance the desirability of a product. But this awareness does not translate into purchasing decisions. That is because although citizens perceive environmental degradation and realize that different choices need to be made, too many of them are still struggling to meet daily needs. Thus, sustainability issues take a back seat (Kamble et al., 2020). In addition, people's level of confidence in buying green products is very low because they are unsure of their eco-friendly nature. This approach based on consumers, therefore, cannot be the only solution to solve the country's MSW problems (Kumar and Agrawal, 2020).

23.3.3 The perspectives

A report drafted by the Ellen MacArthur Foundation (2016) believes that there would be relevant environmental and economic benefits if India adopts the principles of sustainability on a large scale, and also companies would obtain increasing in competitiveness. The path to achieving these expected benefits, however, still appears long.

That is although the Indian Governments' interest in sustainability issues is somewhat dated. In 1986, the *Environment Protection Act* was established, followed by a series of other regulations to support sustainable waste management to protect the quality of the environment and reduce pollution from all potential sources. Unfortunately, these regulations have not been very successful. Therefore, in 2016 a series of more stringent rules were issued for MSW management, including specific requirements for plastic wastes, electronic wastes, construction and demolition debris, biomedical wastes, and hazardous wastes. Despite these regulatory efforts, the Indian economy is expected to generate unrecycled growing waste streams due to increases in population, urbanization, crops, and livestock, resulting in significant human health and environmental impacts even in the following years. The growth of international trade will also contribute to increasing MSW. On the one hand, India exports finished products to Western countries, on the other hand it tends to import end-of-life products to be reused or dismantled to recover valuable components.

More recently, however, pilot projects related to various technologies for the effective utilization of waste have been put into practice, such as waste-to-energy, transfer-storage-disposal, composting, bio-methanation, co-treatment, and some other processes. These waste management initiatives have been able to convert waste streams into business models, introducing integrated management facilities that support the treatment of multiple wastes in a single facility, with low time and cost. At the regulatory level, the main initiatives supporting EC

implementation are the Swachh Bharat Mission launched in 2014, the establishment of a series of waste management rules documents, the renewable energy targets, the publication of the drafts *Nations Resource Efficiency* (2019) and Battery *Waste Management Rules* (2020), and the incorporation of zero-waste policy in SMEs management which constitute the main typology of Indian firm (Nudurupati et al., 2022; Sohal et al., 2022).

However, the low effectiveness of the regulations can be also traced back to the weak attention paid by Government to people engaged in this sector with formal recognition of the waste management industry. This weak attention explains why the industry does not systematically adopt new techniques and technologies for waste collection and sorting (Fiksel et al., 2021).

Another direction being pursued relates to energy production. Given the high incidence of energy poverty, a major challenge for the country is to ensure universal access to clean electricity for the population by 2030 (Sawhney et al., 2016; Gosh et al., 2021). In 2018, the Indian Government announced a renewable capacity target of 227 GW to be achieved by 2022 and 275 GW to be achieved by 2027. However, electricity generated by the plants is only 66.4 MW per day. Operation and maintenance problems hinder the 100% utilization of existing capacity.

Even wastewater is a major challenge. They are about 38,000 million litres per day, but the treatment capacity is lower than 12,000 million litres per day (CPCB, 2009).

Regardless of these efforts, an underlying problem for disseminating EC principles in India concerns a cultural aspect, as the concept of CE is still new, as it is for other developing countries. With the increasing tonnage of waste per year, a pressing need to introduce an innovative cyclic model which implies the use and re-use of waste and to consider "waste as a resource" emerges (Kamble et al., 2020). In this view, consumer acceptance of remanufactured or recycled products is an essential first step to the success of the closed-loop supply chain and to achieving the goal of CE. However, as mentioned above, researchers have verified that consumers are reluctant to purchase remanufactured products. Some investigations (Nudurupaqti et al., 2022; Sohal et al., 2022) show that, nowadays, environmental awareness has a non-significant impact on Indian citizens' consumption choices. But the CE can only be realized if consumers' attitudes are positively modelled toward recycled and remanufactured products. To this end, it would be important to improve communication with citizens through the dissemination of comprehensive product information (Singhal et al., 2019). Therefore, it is necessary to introduce programs to raise people's awareness and affect their purchasing behaviours regarding MSW, train staff to handle safe disposal of MSW, especially e-waste, and produce eco-friendly products (Sharma et al., 2121).

In better detail, about citizens features, it was also noted (Kamble et al., 2020) that the female population shows less awareness compared to the male population, as well as people under 30 years of age. Qualification and high level of education support a higher awareness as well as, in terms of hierarchical levels, employees show an awareness lower compared to that of managers and supervisors. Therefore, progress in the education level could improve the sensitiveness toward CE.

Another type of intervention concerns the *Green manufacturing*, here considered in a generic manner as manufacturing practices that do not harm the environment during any productive phases. Green manufacturing involves the green design of products, use of eco-friendly construction materials and packing, and re-use after the product's end of life. In doing so, it has been demonstrated that the depletion of natural resources and production of trash tend to be reduced (Rehman et al., 2016). By emphasizing rationalizing materials and re-using components, green manufacturing encompasses many manufacturing principles, including 6Rs i.e. reduce, re-use, recycle, recover, redesign, and remanufacture. Thus, *Green manufacturing* contributes to waste management, environmental protection, regulatory compliance, pollution control, and other allied requirements (Sohal et al.,

2022). To improve the effectiveness of this approach, however, it is necessary to involve firstly the myriad small and medium enterprises (SMEs) that comprise the core of India's industrial system. In a large developing country such as India where much of the SME sector is not yet fully organized and often receives limited support by government improvement programs, the journey to become integrated into the CE is very difficult (Nudurupati et al., 2022; Pereira et al.; 2022).

Summarizing, to capture around half a trillion dollars' worth of economic value to be generated through the CE in India by 2030, as forecasted by the *Ellen MacArthur Foundation* (2016), it is important to understand specific challenges that prohibit achievement of the full potential of CE. Some of these challenges regard the supply side. They concern measures such as filling the gaps concerning suitable infrastructure to support "6R" for large quantities of wastes, improving the logistic sector (reverse logistic, circular supply chain…) aimed to support the collection, separation of used materials and extraction of raw materials, and the practices for the diffusion of education/capabilities among companies to undertake the "6R" activities in a safe and environmental-friendly way (Goyal et al., 2018; Sohal et al., 2022). Other measures regard the demand side and are linked to citizens' cultural pattern toward the indispensable sustainability pathways (Mutz, 2015; Sharma et al., 2021). Thus, they include initiatives to change mindset of the "throwaway" society for acceptance of CE related products. Anyway, all the measures presuppose a stronger governmental support through incentives and penalties, with large-scale controls of the performances obtained in the different directions of intervention (Rehman et al., 2016; Kamble et al., 2020). Until now this aspect has been often missing in the Indian legislative context.

23.4. Conclusions

This brief review of the path to the circular economy (CE) followed by these two big countries that are united by an impetuous economic growth exhibits clear differences. On the one hand, China, led by a top-down government approach, shows an early understanding of the need to transition towards CE and is more stringently pointing the way forward for companies and citizens. A choice driven presumably by the goal of consolidating its position as the world's leader exporter with respect to those foreign markets whose consumers are more sensitive to the sustainable development and to the necessity to implement CE pillars. On the other hand, India, in addition to begin its pathway slightly later, has accumulated a further clear gap. That is, although its being the world's largest democracy makes it easier to establish partnerships with Western countries, the social and environmental consequences of the weak attention to sustainability issues are perhaps even more pronounced than in China. However, we must remember that China currently has a higher level of resources to invest in sustainability than India.

A silver lining joining both countries is the growing awareness of the unpostponable need to accelerate the adoption of CE principles. This awareness is certainly positive for the pathway toward the sustainable development of the whole world since these two countries account for nearly 36% of the global population and 22% of GDP. The discussed landscape also let emerge at least three considerations confirming the prevalent literature orientation.

A first observation regards the predisposition toward the adoption of CE principles that seems directly related to the level of well-being of communities. When populations are focused on the most pressing problems related to finding resources to survive, sustainability issues take a back seat. Thus, local authorities of less developed

countries, while perceiving the existence of an environmental and social issue, believe that the problem should be addressed first and foremost by more affluent countries.

A second consideration concerns the fact that it seems equally unrealistic to believe that markets and firms can autonomously lead toward a widespread context of sustainability. If the CE is destined to become the future mantra of economic development, as more and more situations and events are confirming, actions led by institutional bodies at the national as well as international level are indispensable. The adoption of SDGs is certainly, to date, the most striking virtuous example. No less important, at the corporate level, is the growing practice of adopting reporting systems that in some way attest to the ability of companies to achieve economic performance consistent with, if not functional in, the other dimensions of development related to the environment and sociality. Environmental reports or social and sustainability balances, as well as the more advanced integrated reports, certainly represent an important step in this direction.

A third thought concerns the close relationship between safeguarding environmental conditions and social conditions. It is becoming increasingly clear that these two spheres cannot be separated. Where there is social degradation, there also emerges environmental degradation, and conversely. National and international institutions and bodies, therefore, must act with these interrelated dynamics in mind. Similarly, these bodies must consider that without investment in training and technical and technological innovations, it is difficult to pursue a true path to sustainable development.

References

Ardra, S., Barua, M.K., 2022, Inclusion of circular economy practices in the food supply chain: Challenges and possibilities for reducing food wastage in emerging economies like India. *Environ Dev Sustain*. Doi:10.1007/s10668-022-02630-x.

Bleischwitz, R., Yang, M., Huang, B., Xu, X., Zhou, J., McDowall, W., Andrews-Speed, P., Liu, Z., Yong, G., 2022. The circular economy in China: Achievements, challenges and potential implications for decarbonisation. Resources, Conservation and Recycling. 183. Doi:10.1016/j.resconrec.2022.106350.

CPCB (Central Pollution Control Board), 2009, Status of water supply, wastewater generation and treatment in class-i cities & class-ii towns of India, Control of Urban Pollution Series: cups/70.

EllenMacArthurFoundation, 2015. Foundation towards a Circular Economy: Business Rationale for an Accelerated Transition, Cowes, UK.

EllenMacArthurFoundation, 2016. Circular economy in India: rethinking growth for long-term prosperity, Cowes, UK.

European Commission. 2015. Implementation of the Circular Economy Action Plan. https://ec.europa.eu/environment/circular-economy/index_en.htm.

Fiksel, J., Sanjay, P., Raman, K., 2021. Steps toward a resilient circular economy in India. Clean Techn Environ Policy. 23, 203–218. Doi:10.1007/s10098-020-01982-0.

Geng, Y., Doberstein, B., 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. 10.3843/SusDev.15.3:6.

Geng, Y., Fu, J., Sarkis J., Xue B., 2011. Towards a national circular economy indicator system in China: an evaluation and critical analysis. J. Cleaner Prod. 23, 216–224. Doi:10.1016/j.jclepro.2011.07.005.

Ghosh, S.K. 2020. Circular Economy in India. In: Ghosh, S. (eds) Circular Economy: Global Perspective, Springer, Singapore, Doi: 10.1007/978-981-15-1052-6_9.

Ghosh, S.K., Ghosh, S.K., Baidya, R., 2021. Circular Economy in India: Reduce, Re-use, and Recycle Through Policy Framework (183-217). In: Ghosh, S.K. and Ghosh, S.K. (Eds). Circular Economy: Recent Trends in Global Perspective. Springer, Singapore. Doi:10.1007/978-981-16-0913-8_6.

Goyal, S., Esposito, M., Kapoo, A., 2016. Circular economy business models in developing economies: Lessons from India on reduce, recycle, and re-use paradigms. Thunderbird. 60, 5, 729-740. Doi:10.1002/tie.21883.

Joss, S., Molella, A.P., 2013. The eco-city as urban technology: Perspectives on Caofeidian international eco-city (China). Journal of Urban Technology. 20, 1, 115-137. Doi: 10.1080/10630732.2012.735411.

Kamble, C.V., Raju, R. Raman, V., 2020. An awareness study on circular economy in India. Gedrag & Organisatie Review, Doi:10.37896/GOR33.02/259.

Lahane, S., Kant, R., 2022. Investigating the sustainable development goals derived due to adoption of circular economy practices. Waste manag. 143, 15. Doi:1-14 10.1016/j.wasman.2022.02.016.

Li, W., Lin, W., 2016, 'Circular Economy Policies in China'. In: Anbumozhi, V., and Kim, J. (eds.), Towards a Circular Economy: Corporate Management and Policy Pathways. ERIA Research Project Report. Jakarta, 95-111.

Liu, C., Côté, R., 2017. A framework for integrating ecosystem services into China's circular economy: the case of eco-industrial parks. Sustainability. 9. Doi:10.3390/su9091510.

Liu, L., Liang, Y., Song, Q., Li J., 2017. A review of waste prevention through 3R under the concept of circular economy in China. J. Mater. Cycles Waste Manag. 19, 1314–1323. Doi:10.1007/s10163-017-0606-4.

Lyu Y., Liu Y., Guo Y., Sang J., Tian J., Chen L., 2022. Review of green development of Chinese industrial parks. Energy Strategy Reviews. 42. Doi:10.1016/j.esr.2022.100867

Mathews, J.A., Tan, H., 2011. Progress Toward a Circular Economy in China. Journal of Industrial Ecology. 15, 3, 435–457. Doi:10.1111/j.1530-9290.2011.00332.x.

Mathews, J.A., Tan, H. 2016. Circular economy: Lessons from China. Nature. 531, 440–442. Doi:10.1038/531440a

Mathews, J.A., Tan, H., Hu, M.C., 2018. Moving to a circular economy in China: transforming industrial parks into eco-industrial parks. Calif. Manage. Rev. 60, 3, 157–181. Doi:10.1177/0008125617752692.

McDowall, W., Geng Y., Huang B., Barteková E., Bleischwitz R., Türkeli S., Kemp R., Doménech T., 2017. Circular economy policies in China and Europe. J. Ind. Ecol. 21, 3, 651–661. https://doi.org/10.1111/jiec.12597.

Mohajan, H., 2021, Circular Economy in China: Towards the Progress, International Journal of Economics and Business Administration, 7, 3, 89-96.

Mutz, D., 2015. Circular economy and informal waste management in India - A contradiction?. Institute of Development Studies. Resource Politics, Steps Center.

Kumar A., Agrawal A., 2020, Recent trends in solid waste management status, challenges, and potential for the future Indian cities – A review, Current Research in Environmental Sustainability, 2, Doi: 10.1016/j.crsust.2020.100011.

Nudurupati, S.S., Budhwar, P., Pappu, R.P., Chowdhury, S., Kondala, M., Chakraborty, A., Ghosh, S.K., 2022. Transforming sustainability of Indian small and medium-sized enterprises through circular economy adoption. Journal of Business Research. 149, 250–269. Doi:10.1016/J.JBUSRES.2022.05.036.

Pereira, V. Nandakumar M.K., Sahasranamam S., Bamel U., Malik A., Temouri Y., 2022, An exploratory study into emerging market SMEs' involvement in the circular Economy: Evidence from India's indigenous Ayurveda industry, Journal of Business Research, 142, 188-199, doi:10.1016/j.jbusres.2021.12.053.

Pesce, M., Tamai, I., Guo, D., Critto, A., Brombal, D., Wang, X., Cheng, H., Marcomini, A., 2020. Circular Economy in China: Translating Principles into Practice. Sustainability. 12, 832. Doi:10.3390/su12030832.

Qi, J., Zhao, J., Li, W., Peng, X., Wu, B., Wang, H., 2016. Development of Circular Economy in China. Springer, ISBN 9789811024665.

Rehman, M.A., Seth, D., Shrivastava, R.L., 2016. Impact of green manufacturing practices on organisational performance in Indian context: an empirical study. J. Cleaner Prod. 137, 427–448. Doi:10.1016/j.jclepro.2016.07.106.

Sawhney, A., 2021. Striving towards a circular economy: climate policy and renewable energy in India. Clean Techn Environ Policy. 23, 491–499. Doi:10.1007/s10098-020-01935-7.

Sharma, M., Joshi, S., Govindan, K., 2021. Issues and solutions of electronic waste urban mining for circular economy transition: An Indian context. J. Environ. Manage. 290. Doi:10.1016/j.jenvman.2021.112373

Singhal, D., Tripathy, S., Jena, S.K., 2019. Acceptance of remanufactured products in the circular economy: An empirical study in India. Management Decision. 57, 4. Doi:1.1108/md-06-2018-0686.

Sohal, A., Ashwini, A. Goyal, N.P., Bhattacharya, A., 2022. Developing a circular economy: An examination of SME's role in India. Journal of Business Research. 142, 435-447. Doi: 10.1016/j.jbusres.2021.12.072.

Su, B., Heshmati, A., Geng, Y., Yu, X., 2013. A review of the circular economy in China: moving from rhetoric to implementation. J. Cleaner Prod. 42. Doi:10.1016/j.jclepro.2012.11.020.

Utkarsh P., Ahluwalia I.J., 2018. Solid Waste Management in India. An Assessment of Resource Recovery and Environmental Impact. Working Papers id:12746, eSocialSciences.

Yaduvanshi, N., Myana, R., Krishnamurthy, S., 2017. Circular Economy for Sustainable Development. Indian Journal of Science and Technology. 9, 46. 10.17485/ijst/2016/v9i46/107325.

Yong, R., 2007. The circular economy in China. J Mater Cycles Waste Manag., 9, 121–129. Doi:10.1007/s10163-007-0183-z

Yuan, X.L., Liu, M., Yuan, Q., Fan, X., Teng, Y., Fu J., Ma. Q., Wang. Q., Zuo. J., 2020. Transitioning China to a circular economy through remanufacturing: a comprehensive review of the management institutions and policy system. Resour. Conserv. Recycl. 161. Doi:10.1016/j.resconrec.2020.104920.

Zhu, Q., Geng, Y., Lai, K.-H., 2010. Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. J. Environ. Manage. 91, 6. 1324–1331. Doi:10.1016/j.jenvman.2010.02.013.

Zhu, J., Fan C., Shi, H., Shi, L., 2019. Efforts for a Circular Economy in China: A Comprehensive Review of Policies. Journal of Industrial Ecology. 23, 1. Doi:110-118, 10.1111/jiec.12754.

Ledizioni Ledipublishing
via A. Boselli 10, 20136 Milan, Italy
www.ledipublishing.com

PDF ISBN: 9791256001446
DOI: 10.5281/zenodo.10958884

Catalogue and reprints information: www.ledipublishing.com

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

JUST2CE

A Just Transition to Circular Economy