# Chapter 13
# The Future of Circular Economy and Zero Waste


**María-Laura Franco-García, Jorge Carlos Carpio-Aguilar, and Hans Bressers**

**Abstract** This chapter provides a reflective analysis of the contributions focusing on how the chapters contribute to circular economy in two main themes that will define the future of circular economy research: challenges and opportunities and effective collaboration with stakeholders. Lessons learned and commonalities are also discussed to finally draw some conclusions and recommendations to further elaborate the research agenda of this field.

**Keywords** Circular economy · Collaboration with stakeholders · Zero waste

## 13.1 Country-Specific Challenges and Opportunities

One of the lessons from the chapters is that challenges and opportunities have been so far somewhat generically described in the literature, which tends to assume a universal view of challenges and opportunities, where the lessons from developed countries can be without a problem translated to developing countries. We argue that a more contingent approach is needed, taking into account deep structural, institutional and cultural differences between countries. In other words, our understanding of circular economy (CE) challenges and opportunities needs to be geographically and socially embedded to understand country-specific differences. Accordingly, in Chap. 2, Dieleman and Martínez analysed opportunities and challenges of CE in Mexico from a wide systemic perspective inspired by the concept of national innovation systems and its emphasis on distinctiveness of contextual conditions. To frame their discussion, they used the components of such concept, i.e. (i) "market trends and conditions"; (ii) "competitiveness and productivity"; (iii)

M.-L. Franco-García (✉) · H. Bressers
University of Twente, Enschede, The Netherlands
e-mail: m.l.francogarcia@utwente.nl; j.t.a.bressers@utwente.nl

J. C. Carpio-Aguilar
Walmart Mexico, CDMX, Mexico
e-mail: jorge.carpio@walmart.com



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"the political and regulatory framework"; (iv) "education, training and knowledge transfer"; and (v) "learning culture". As part of the opportunities, (i) the market conditions and long-term market trends in the country are positive; (iii) the regulatory framework through the country's National Development Plan aims at stimulating green growth; (iv) since the 1990s, environmental education nationally exists as well as knowledge transfer systems; (v) Mexicans' openness to new technology induced practices. In contract, serious challenges are also mentioned: (i) markets are not flexible, and there is lack of bank credits allocation in the long term; (ii) a culture that restricts innovation and creativity and a desire to shape and control the future leaves Mexico with poor seizing opportunities; (iii–iv) discrepancy between the creation and execution of policy and the environmental education plan is another real challenge; (v) the needed rather experimental and learning-by-doing educational approach to address CE shows limitations of the current Mexican learning culture. The authors emphasised this last element because it influences how the economy and society function and therefore represents one of the biggest challenges to overcome.

In particular within the waste sector, in Chap. 3, Ghinea and Gavrilescu analysed the Romanian waste management policy framework and practices to identify challenges and opportunities of CE goals. As a result, they suggested strategic solutions for integrated waste management and policies for its improvement. With the help of the life cycle assessment methodology, eight waste management scenarios were assessed. The first one was used as baseline (collection, transportation and landfilling) for the comparison with seven hypothetical scenarios which are constructed following the principles of Lansink's ladder (2010). As mentioned in Chap. 1, Lansink's ladder emphasises the relevance of preventing waste generation during its management. The best scenario according to the environmental categories of the LCA methodology was the scenario that integrates separate collection by waste streams, recycling of those materials, composting of organic waste and incineration of the residual waste.

Seeking for possibilities to embed CE at the country level, Cruz-Pastrana and Franco-García in Chap. 4 explored the feasibility to implement a cap-and-trade system (C&TS) to mitigate climate change effects which has been widely applied in other countries but not in Mexico. In such context, CE can offer additional possibilities to embrace C&TS generating both environmental and economic benefits. Hence the purpose of this chapter was to explore the C&TS feasibility in Mexico and to highlight the implications of considering CE models into a cap-and-trade instrument. Approaching this intention by using MACC (marginal abatement cost curves), 57% of all the measures to reduce GHG with negative cost agglomerates could contribute almost 1% to the GDP by 2020. Based on MACC calculations, the chapter argued that C&TS is potentially feasible in Mexico, even further as the attached carbon price by end-users might be a strong motivation to integrate CE tenets to their operations, bringing new innovative opportunities to close materials' and energy loops.

## 13.2 Stakeholders

Moving forward, the rest of the papers in this volume were introduced by following the stakeholder structure which was outlined in Chap. 1. We started with papers that clearly showed the public sector as one of the most influential stakeholders, in particular when it concerns the "household solid waste management" which is the focus of Chaps. 5 and 6. In the case of Chap. 7, a governmental programme to stimulate the urban symbiosis (recycling) implementation in China was the core of the analysis, whilst in Chap. 8 the Indonesian higher education management was the focus, education being one of the public sector's responsibilities. Universities were discussed as the intellectual cradle for the transition from linear to circular economy trends.

### *13.2.1 Stakeholder Promoter: Public Sector*

It is not a coincidence that the authors (Suherman et al.) of Chap. 5 elaborated their case under the stakeholder identity and salience framework for their analysis of the household solid waste management in Cimahi City, Indonesia. In effect, the theory of stakeholder identity and salience by Mitchell et al. (1997) is the core analytical tool applied to this Indonesian case that to some extent reflects the current situation of the majority of cities in the country. Authors have a double interest whilst conducting this research; the first one is to approach systematically the identification and classification of the stakeholders involved in the household solid waste management in Cimahi City and secondly to detect the specific stakeholders who would be entitled to lead the transition towards circularity patterns of the solid waste management. Moreover, collaborative schemes for such transition can be discussed and designed by engaging those salient stakeholders. As one of the main findings of this research, it proved possible to identify and classify the stakeholders in Cimahi City for the household waste management into two meaningful categories: (i) the formal sector (government, NGOs and private ones) and the (ii) informal sector (not officially registered waste collectors and recycling entities).

Díaz and Tinoco-Castrejón presented in Chap. 6 the efforts of the government of Cuautlancingo, Puebla, Mexico, to transit the urban solid waste management towards circular economic practices. They interviewed governmental stakeholders to diagnose the current practices that resemble those of CE and validated such information through either secondary information sources or interviewing other stakeholders who were to some extent directly involved in the waste management. Based on the evidence, the authors showed that in spite of the municipal efforts to provide proper waste collection and disposal services, the urban solid waste management in Cuautlancingo is lagging behind when comparing it with what circular economy promotes. There is a consensus among stakeholders that the more discharged materials during production and post-consumption can be recycled within companies, a

higher productivity level of the municipality can be achieved because this means a reduction of the materials to be treated or disposed by municipalities. The use of indicators to boost circular economy practices is suggested, such as the resource consumption rate (per capita), rates of segregated and recycled materials and rates of waste used for energy recovery. Additionally, local government is recommended to formulate regulations and policies in order to ensure the environmental care and responsible acting of the citizens. This should be integrated with awareness campaigns about waste management opportunities for the community. Openness for collaboration with other stakeholders was enthusiastically mentioned whilst talking to governmental officers.

Chapter 7, entitled "A Massive Urban Symbiosis: A Preliminary Review of the Urban Mining Pilot Bases Initiative in China", written by Xue et al. aims to bring the Chinese urban mining pilot base (UMPB) case under the light of the governance assessment tool (Bressers et al. 2016). The research question driving this work is what are the typical features as a "massive urban symbiosis policy" that the Chinese urban mining pilot base (UMPB) programme represents and to what extent can they be improved? The UMPB is a Chinese governmental initiative to stimulate recycling of key materials as the main urban symbiosis activity that links efficient material flows between production and consumption, the industry sector and the urban sector. The urban symbiosis (a concept derived from industrial symbiosis) is also in China framed under the CE policy and has been embedded into China's urban mining pilot base (UMPB) programme that promotes the growth of the recycling industry and the use and development of advanced technology to cope with high-value recycling practices. The current 45 pilot bases with a planned 6.6 billion tonnes per year capacity indicates that a massive urban symbiosis effort is taking place in China. Moreover, this paper shows that the driving force of waste recycling management in China is moving from an environmental and recycling angle to resource strategies. Despite UMPB's legal and subsidies assurance, this does not reflect the creation of a perfect governance context for its implementation. On the contrary, some incoherencies and policy conflicts were detected at the multi-ministerial cross-management network, who are the actual UMPB implementers. Those represent some of the main barriers (challenges) for this programme.

In Chap. 8, "Incorporating Circular Sustainability Principles in DKI Jakarta: Lessons Learned from Dutch Business Schools Management", Nurdiana et al. analysed the experiences of the integration of circular economy into the Dutch high education curricula with the purpose of using them as reference for the Indonesian higher education system. The authors identified the need to expand the concept of "green university" to the broader concept of CE. This is due to the important role universities play in societies, forming capacities to face current and future societal challenges, especially those oriented to cope with resource scarcity and pollution effects. As part of the findings in Indonesia, it can be mentioned here that the Indonesian universities have a relatively narrow view, whilst the Dutch cases analysed present a more holistic approach towards sustainability and CE, offering them some extra manoeuvre opportunities for the inclusion of CE education.

### *13.2.2 Stakeholder Promoter: Private Sector*

The internationally operating supermarket chain Walmart in its Mexico operations has identified food waste as a niche for improvement as described in Chap. 9, where the concept of zero waste to landfill (ZWTL) was explored with the intention to ameliorate the organic waste management. ZWTL pursues prevention and reduction of wastes at their source of generation, which effects are in line with CE principles. In fact, Rincón-Moreno et al. suggest that "circularity" would increase productivity throughout the food supply chain if it became part of the business strategy. In order to test this, a showcase was selected to explore how the organic waste management can be improved by combining a CE business model and a ZWTL strategy. After analysing the data of the organic composition of the wastes (from the show case), the authors elaborated upon the idea that most of the food considered as waste can be recovered through different stages. Even further, 40% of the food waste management costs can be saved through three business actions associated with those recovery stages. The proposed framework intends to collect all the sustainable concepts that might potentially be resembled in other industries with similar challenges. The findings showed that most of the food which is considered waste (discharged organic products) can be recovered through different operations within the shop facilities: inventory management, first expired-first out, donations, livestock feed and a biodigester to generate electricity. The biodigester represents the most important investment, though 40% of the food waste management costs can be saved through three of the business actions associated to those recovery stages. Through the conduction of this project, a combined framework (SOL4FoodWaste) is elaborated and discussed.

The PetStar PET bottle-to-bottle recycling system, a zero-waste circular economy business model, was presented in Chap. 10. Cámara-Creixell and Scheel-Mayenberger emphasised the point of finding ways to organise the PET bottles post-consumption enabling PetStar to successfully contribute to the plastic recycling industry. Participation of three stakeholders involved in the industry – the environment, society and business – requires a different business model in which all actors can participate and produce a more inclusive added value. This is mentioned in reflection on the scavenger's conditions as an important stakeholder in the PET bottle recycling value chain. Scavengers mostly operate informally, resulting in their exclusion from traditional business models. At this regard, "PetStar is a company that has designed and implemented a Circular Economy business model for PET bottles that is trying to achieve a dream for the recycling industry, i.e. to disengage the recycled bottle from virgin resources, avoiding the conversion of the packaging to waste, and operate a perennial cycle in the use of the packaging". This case disclosed how their business model is operated in a sustainable way: economically feasible and competitive whilst environmentally resilient and socially oriented towards the poorest and most informal sectors, the scavenger and collector communities. Even beyond their own market boundaries, there is a strong belief that conditions can be created to enable replicability of their model of sustainable

recycling to other developing countries where the potential of zero-waste circular value systems is well perceived by a large number of stakeholders in the PET bottle value chain.

In Chap. 11, the concepts of social life cycle assessment (S-LCA) and combined social and environmental LCA (SELCA) were explored through the application of existing LCA methods to the global value chain of denim jeans. Franco-García et al. reported on the SELCA method from this explorative research. The inclusion of the social component into the assessment of the denim jeans' showcase contributes to the battery of impact assessment tools for products whose value chain scope is multinational (global). Four scenarios for jeans assembly were compared; three of them are defined under the circular economy (CE) principles by including recycled materials (cotton, PET and nylon 6) during the yarn production. During the application of the SELCA method, some new challenges were encountered related to inventory analysis, in particular during data acquisition for social inventories. This last aspect is mainly due to the extensive list of key stakeholders for the showcase and the qualitative nature of the social metrics used. The list starts with cotton cultivators from different countries where regulations and codes of conduct seem to have contextualised interpretations and consequently different levels of implementation. In this regard, governmental intervention to instrument the transition towards suitable social/environmental performance along the global jeans value chain was also discussed in this paper.

### *13.2.3 Stakeholder Promoter: Civil Society*

Plasencia-Vélez et al. presented Chap. 12 "A Circular Model of Residential Composting in Mexico State". This is the description of a composting project led by a civil society group within the physical borders of a residential unit nearby Mexico City. They produce compost from their own organic wastes, closing the loop by creating a product that nourish inner gardens of their residential area. The authors provided an in-depth description of their case arguing that their research contributes to the CE studies, in particular addressing the participation of households and, by this, showing that CE practices can be promoted by anyone who perceives the potential of discharged materials to be reintegrated into the natural biological cycle. The Mexican urban solid waste (USW) has a high organic component (45–55%) that can be potentially recovered and transformed as the households of Club de Golf Bellavista showed in this research. For the authors, this is a grass-roots example with positive effects on the USW management. Hence, with the intention to deploy its potential at a larger scale, the purpose of this research was to identify the necessary conditions for this type of projects to be successful. Therefore, it is important to identify and analyse similar cases, in order to learn from the existing best practices. Looking beyond the borders, British and Dutch cases are also analysed through an analytical framework constructed from specialised literature. It is used to assess the case in Mexico State by the means of surveys and semi-structured

interviews. Among the most relevant findings, "social participation" came consistently across as a relevant success factor in this type of grass-roots initiatives. Additionally, promoters of this case gave suggestions about ways to engage the other neighbours in the separation phase of USW.

## 13.3 Concluding Overview and Suggestions for Future Research

The Ellen MacArthur Foundation (2015), SUN and McKinsey have estimated that "by adopting Circular Economy principles, Europe can create a net benefit of €1.8 trillion by 2030, or €0.9 trillion more than in the current linear development path". Certainly, it is much easier to calculate monetary benefits than to implement the necessary instruments to transit to a more circular economy through the current complexity of value chains. The transition needs to involve product designers, business developers, investors, marketers, managers, consumers and every single person of the society who has to deal with any type of discharged resources (waste) and can still see its value as a resource. More importantly, stakeholders are needed to bring the resources back to any of the closed material (resources) loops to avoid landfilling to its maximum expression (zero waste). This implies full systemic change and innovation at different levels: technological, organisational, social, financial and policy level. It is though expected that even in a highly CE scenario, there will remain some elements of linearity as virgin resources are required and ultimate residual materials are disposed of. Some technological challenges stem from the current waste treatment facilities, such as incinerators that do not fit within the CE principles. To deal with that some countries, e.g. the Netherlands, have considered a midterm plan to gradually transform low-efficient incinerators into specialised recycling and reuse facilities.

Also relevant is the growing movement of critical think-tanks to further develop new paradigms to practise the CE tenets. The number of approaches and business models to be considered grows constantly due to the sense of urgency produced by the foreseen beneficial potential of CE. Cramer (2014), for instance, has reported nine circularity schemes which at the same time imply the integration of related business models. Here is the list of her 9Rs: (i) refuse, prevent the use of resources; (ii) reduce, decrease the use of resources; (iii) reuse, find new product use (second hand); (iv) repair, maintain and repair; (v) refurbish, improve product; (vi) remanufacture, create new products from second hand; (vii) repurpose, reuse product for different purposes; (viii) recycle, reuse raw materials of product; and (ix) recover, recover energy from waste.

Historically, the practice of the 9Rs has been observed at a small and individual scale, but the real challenge is to scale them up into collaborative platforms where resource flows create value and close the production loops into a zero-waste system. The businesses that have invested in innovations like new material recovery methods

and material substitution are expected to play a leading role on this because they have an influential position within their networks and stakeholders. On the other hand, the efforts of the private sector require the support of policy instruments and the consumer participation, as it was repeatedly mentioned in the cases here presented.

To sum up, the following reported barriers can be turned into the focus of further research along the ongoing CE implementation: (1) institutional barriers posed by existing business models, (2) organisational barriers as a result of poorly coordinated efforts, (3) legal barriers hampering innovation to some extent, (4) economic barriers that focus on current business models, (5) behavioural barriers to change consumers' attitudes, (6) environmental commitments associated to local and international agreements and (7) technological barriers that prevent incremental innovations.

With no doubt, technological innovations are a must in the transition towards CE, but it can also be argued that innovation is not always the panacea when the end-of-life of some materials represents a barrier by itself or not all the materials might be improved or substituted. Hence, in some cases, producers have to compromise the toxicity level of some ingredients in the formulation of their products, simply because they cannot sacrifice the product quality. In other cases, producers have important suppliers who cannot be replaced or do not agree to provide information on their materials. A way to overcome the reluctance to open up the flux of information could be by a suitable policy mix that regulates the transparency of information and/or stimulates purchasing circular products.

In regard to the local and international environmental agreements, e.g. greenhouse emission reduction (Paris 2015), CE is foreseen as a contributor to achieve the Paris' targets by including, for instance, a $CO_2$ tax per product which could result in a more realistic price of products and simultaneously have impact on Sustainable Development Goal 12 (responsible production and consumption). In reality, a plethora of environmental costs are not yet internalised in the product price, so this can be an opportunity to also reduce the prices of some products when they proved to be produced under any (or similar) of the 9R (Cramer 2014) frameworks.

The CE and ZW nexus deploys, as it was here above briefly discussed, a large number of current and future research opportunities. The chapters compiling this book have tried to illustrate such potential, but we, as editors, have to admit that the CE topic is such a prolific and dynamic field that results, currently, impossible to completely describe it. In other words, this book aims to be a piece of "work in progress" that connects two relevant topics to transform wastes into resources: CE and ZW.

## References

Bressers H, Bressers N, Kuks S, Larrue C (2016) The governance assessment tool and its use. In: Bressers H, Bressers N, Larrue C (eds) Governance for drought resilience: land and water drought management in Europe. Springer International Publishing, Cham

Cramer J (2014) Milieu. Elementaire Deeltjes: 16. Amsterdam University Press B.V, Amsterdam

Ellen MacArthur Foundation (2015) Towards a circular economy. Ellen MacArthur Foundation, Brussels

Lansink A, de Vries H (2010) – in 't Veld, De Kracht van de Kringloop; Geschiedenis en Toekomst van de Ladder van Lansink (The power of closing the loop; history and future of the ladder of Lansink). Vrilan, Apeldoorn

Mitchell RK, Agle BR, Wood DJ (1997) Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts. Acad Manag Rev 22(4):853–886