Chapter 6
The Urban Solid Wastes Management in Cuautlancingo, Puebla, Towards a Circular Economy: Social and Economic Impacts of CE to the Region – Innovative Business Models

Luz del Carmen Díaz-Peña and Miguel Angel Tinoco-Castrejón

Abstract The purpose of this paper is to describe how Cuautlancingo, a local government of Puebla, México, manages circular economy (CE) activities related to urban solid wastes (USW). The final goal of those activities is to reduce potential sources of soil/water contamination and to preserve the environmental conditions. Due to the CE systematic approach, several stakeholders are required to integrate their efforts. Government and companies represent key stakeholders who can adopt the circular economy as a systematic thinking approach to make decisions accordantly. Hence, this paper was focused on trying to identify and describe the CE systematic approach in Cuautlancingo, as a case study. Three main points of attention were used for this analysis: (1) the wastes collection methods applied; (2) the type and conditions of waste management and (3) how does a circular economy perspective can influence other business or companies to recycle waste and generate more employment possibilities. The research methodology used was of qualitative nature. The main research method consisted of a questionnaire which was applied to staff members of the local government in Cuautlancingo. Aspects associated to the USW, such as generation, use and their treatment were the focus of the questionnaire. Some of the findings shed light on the poor CE implementation associated with USW management. However, some opportunities could also be identified, i.e. if the local government assumed the responsibility to organise and sell the recyclables, this would represent an additional income up to 366 USD per month. Consequently, it is perceived the need of redesigning the USW processes to retain the material value within the CE perspective.

Keywords Urban solid waste management · Cuautlancingo · Mexico · Circular economy

L. del Carmen Díaz-Peña (✉) · M. A. Tinoco-Castrejón
Instituto Tecnológico y de Estudios Superiores de Monterrey, Puebla, Mexico
e-mail: luzdiazp@itesm.mx; mtinoco@itesm.mx

M.-L. Franco-García et al. (eds.), *Towards Zero Waste*, Greening of Industry Networks Studies 6, https://doi.org/10.1007/978-3-319-92931-6_6

6.1 Introduction

Many scholars have written about the weak waste management system to cope with the global waste generation which yearly sums about 10,000 millions of tons. Less than half of them is collected and in the best circumstances also recycled. In the specific situation of Mexico, the per capita generation reaches 360 kg of waste per year (OECD 2015). Therefore, solid waste management can be linked to concepts like the CE in order to identify the opportunities to transform "waste" into "material" streams again.

In 2008, the Organisation for Economic Co-operation and Development (OECD) announced that there were 10,000 million tons of waste per year around the world and not even the half of them were conducted into a recycling treatment. Municipal waste represents only 10% of total waste, but its management and treatment can represent more than one-third of public sector financial efforts to abate and control pollution. Inappropriate waste management impacts human health and the environment due to soil and water contamination, air quality, climate, land use and landscape. In fact, the global biodiversity loss is projected to continue, with a further 10% loss by 2050 (OCDE 2015).

In Mexico, every year, the population generates 31.5 millions of tons of waste at their homes, stores and public areas, approximately 0.65% of it ends up in the streets as litter and 14.5% is burned up. According to the OCDE (2015), Mexico is the 25th country in the world that generates more kilogrammes of waste per capita: 360 kg of waste per year. In this setting, an approach that can contribute to the abatement of pollution and to the world climate change is the CE. The concept of the circular economy has gained increasing prominence in academic, practitioner and policy circles. Circular economies are achieved mostly through global recycling networks which are the primary means by which wastes are recovered as resources (Gregson et al. 2015).

Cuautlancingo was selected as a case in point to analyse the CE tenets because it represents one of the most important cities of the state of Puebla in Mexico, with similar demographic characteristics than other cities in the country. Even further, this case clearly displays recycling treatment practices of the urban solid wastes and its social and economic implications.

The collection, waste disposal, hygiene and cleanliness of marketplaces and other services are today's challenges of Cuautlancingo; if those are not attended in an efficient way, they will have a negative direct impact on the community quality.

The first part of the paper is an overview of the CE concept and principles, some of its benefits and the descriptive information of Cuautlancingo. In the second section, the research methodology is deployed including the data analysis methods. Results are presented and discussed in the third section to finally leave space to the conclusions and recommendations for further research about practical implications that may improve the management decisions that take circular economy principles into account.

The article starts by presenting an overview of the CE concept and some of its benefits, such as the improvement of economic results at the same time as reducing the use of resources by innovative ways. Increasing efficiency of resources management can indeed prevent environmental pollution and depletion and all in all contribute to climate change mitigation.

6.2 The Concept of Circular Economy (CE)

The idea of circular material flows, as a model for the economy, was presented in 1966 by Kenneth E. Boulding in his paper "The Economics of the Coming Spaceship Earth". Promoting a circular economy was identified as a national policy in China's eleventh five-year plan starting in 2006. The Ellen MacArthur Foundation, an independent charity, established in 2010, has more recently outlined the economic opportunity of a circular economy. As part of its educational mission, the foundation has worked to bring together complementary schools of thoughts and create a coherent framework, thus giving the concept a wider exposure and appeal.

Shi et al. (2006) defines the concept of CE as the interlinked manufacturing and service businesses. The promoters of CE seek the simultaneous enhancement of economy and environmental performance through collaboration by managing environmental and resource issues. By working together, the community of businesses seeks a collective benefit that is larger than the sum of the individual benefits of each enterprise, industry and/or community.

CE promotes a harmoniously economic development pattern with the earth. The main purpose of CE is to organise the economic activities to a close-loop process of "resource-production-consumption-regenerated resource". All materials and energy can be used rationally, efficiently and continuously in sustainable economic cycles; hence, the harmful effect to the natural environment can be reduced to a minimum. The principles of CE are based but not exclusively related to the "reduce, reuse and recycle" (3Rs) (Shi et al. 2006).

The implementation of CE strategies is expected to achieve an efficient economy rate while discharging fewer pollutants, although the CE strategy requires complete reform of the whole system of human activities, which includes both production processes and consumption activities. It has been widely explained that CE could help to improve resource productivity and eco-efficiency, reform the management of the natural resources and achieve sustainable development standards (Yuan et al. 2006). Activities over the past several years, however, clearly show that CE is emerging as an economic strategy rather than a purely environmental preservation approach. The major objective of the government is to promote the economic and environmental dimensions of the sustainable development concept (Yuan et al. 2006).

Another CE definition was given by "The Ellen MacArthur Foundation", which is: "CE is one that is restorative by design, aiming to keep products, components

and materials at their highest utility and value at all times, distinguishing between technical and biological cycles. The distinction between biological and non-biological products has the purpose to maximise the materials value recovery. It is based on renewable resources – either grown or circulated within the economy at high value". The circular economy has no wastes: only resources designed to be feedstocks for other products (The Ellen MacArthur Foundation 2013).

The development of the CE has brought with it the conclusion that this approach would be more efficient for the resource productivity if it focuses on adjusting industrial structure, developing new technology and reforming industrial policy, rather than just recycling waste.

In the same line but at the consultancy level, "The Green Gain" firm is a specialist in the circular economy, innovation and enterprise. It has experience of working with organisations on sustainable waste, water and energy efficiency and helps them to respond to changing markets and increasing resource prices through a range of strategic and practical approaches. Moreover, Green Gain (2016) presented some key features of circular economy thinking, which are:

- **Whole system design:** an effective circular economy for a product is much more likely to be achieved if everyone involved are incentivised towards the same outcome.
- **Design for end-of-life recovery**: the repair, refurbishment and remanufacture become more commercially viable.
- **New business models:** selling the function of a product rather than the product itself means that the supplier retains ownership of the product and is incentivised to design for durability and end-of-life recovery.
- **Diversity:** a wide variety of circular economy solutions applied at different scales will provide a resilient and adaptable foundation.
- **Biomimicry:** copying systems used in nature – seeing ecosystems as a template for a circular economy and its elements.
- **Innovation:** the process includes invention, creativity, experimentation, entrepreneurship and collaboration.

6.2.1 Global Perspective of CE

In 2015, a report was released entitled Towards the Circular Economy: Economic and Business Rationale for an Accelerated Transition. The report, commissioned by the Ellen MacArthur Foundation and developed by McKinsey & Company, was the first of its kind to consider the economic and business opportunities for the transition to a restorative, circular model. "The Ellen MacArthur Foundation, SUN, and McKinsey have identified that by adopting circular economy principles, Europe can take advantage of the impending technology revolution to create a net benefit of €1.8 trillion by 2030, or €0.9 trillion more than in the current linear development path" (Ellen MacArthur Foundation 2013).

In March 2014, "Resource" did the first large-scale event in London for the CE with over 11,000 attendees from across the globe representing all the major stakeholders. The launch of such an event signals the rise of the topic, and it will act as an enabler for business to transit towards more circular business models. "Resource" is built around the needs of companies that want to save and make money through reducing waste, recycling, recovery and repair, but now these companies are looking to take the next step towards resource efficiency and the circular economy. Resource connected professionals from across the textiles, automotive, food, retail, chemicals, construction and electrical industries to help them to learn about the circular economy, network and find new partners and solutions. The 2016 Conference brought together leaders from across Europe to share the latest thinking, insight and analysis around corporate resource efficiency and circular economy modelling (Resource 2015).

6.2.2 Mexican Perspective of CE

Regarding the circular economy in Mexico, there is no much information or statistics about it (2015). The perception is that it is a relatively new concept, and the large companies are mainly the ones that are adopting important environmental standards as part of their voluntary policies. Some improvement of their CE's processes through the ISO 14000 certification has been reported, for instance, Heineken Mexico announced its admission at the "CE 100 Programme" created by the Ellen McArthur Foundation. On the other hand, very few of the micro and small companies decided to add environmental care as part of their regular activities (Carrillo et al. 2010).

From the legal-institutional viewpoint, the environmental policies in Mexico are framed in the "Political Constitution of the United Mexican States" and the "Ministry of Environment and Natural Resources" (SEMARNAT[1]). This latter is on charge to develop and implement more specific laws, norms and create institutes. The most important laws related to CE are Organic Law of the Federal Public Administration, the General Law of Ecological Balance and Environmental Protection and the General Law for the Prevention and Integral Management of Wastes. These laws state that each federative and local entity in Mexico has the responsibility to create, manage and evaluate its own environmental legislation in order to preserve and restore the ecological balance of the physical environment. In the last decades, it has been seen that these entities do not have neither capacities in place to face the environmental challenges nor the budget and infrastructure (Carrillo et al. 2010). More recently, a real effort for having an institutional structure and legislation is perceived. The main environmental issues they have been working at are potable water, drainage, sewage system, collection and final waste destinations and the creation of ecological reserves zones (Carrillo et al. 2010).

[1] Acronym in English

From the practitioner's perspective, through this research, it could be identified three organisations in México that have used the circular economy: "Zero Waste", "Urban Island" and "Bio bag System". A short description of each of them is mentioned as follows.

"Zero Waste" is a company that collects industrial and landfill's wastes. It also recycles and transforms them into new materials like sheets, carpets, daises or scholar's tools. These products are again integrated in the consumption chain as a fully recycled products. In the case of "Urban Island", they collect rainwater through a piping system and bring it to homes, schools and isolated zones. The interesting point here is that the main resource is from a natural source. This organisation is located in Mexico City and has more than 2000 catchment systems that benefit more than 10,000 persons at country level. In the case of "Bio bag System", this company produces, installs and sells biodigesters that treat organic wastes such as manure. With a decomposition process, the wastes are used for biofuels and compost production. These biodigesters are installed mainly in farms, schools and rural areas for more than 12,000 users.

6.3 Urban Solid Wastes (USW)

As definition, wastes are those materials and products whose owner throw away and that stay in a solid or semi-solid, liquid or gas state in a container or tank. They can be valued or required to a specific final treatment. According to their characteristics and origins in Mexico, they can be classified into three groups: (1) hazardous wastes, (2) special use wastes and (3) urban solid wastes (organic and inorganic) (General Law for the Prevention and Integral Management of Wastes 2003).

The world population is growing at a rate of 1.6% per year (country meters 2015); thus, the urbanisation and urban wastes are also growing and contaminating the air and the groundwater when they are not properly managed. At the same time, the natural resources are becoming depleted. In this sense, all the individuals need to be conscious about these social and environmental problems. In a minor scale, counties and town councils (boroughs) have a direct, immediate and unavoidable responsibility towards the environment. A few years ago, they were not regarded as priority functions of the counties. At present, they have not only a basic legal obligation but the social commitment of the local government to the population (Pichardo 2009).

The urban solid wastes (USR) are generated in houses and shelters, streets and public places as a result of the material consumption that were used (General Law for the Prevention and Integral Management of Wastes 2003). These kinds of wastes have a very slow decomposition because of their chemical characteristics, and even though most of them are from a natural origin, they are not biodegradable. Generally, the USW are recycled through artificial and mechanical methods as it is the case of cans, glasses, plastics and gums (Mantra n.d). In 1998, 85% of the USR in Mexico were collected and in 2011 93%, but only 4.8% of them were recycled (SEMARNAT 2012a, b).

Table 6.1 USW in Mexico 2014 (SEMARNAT 2014 & compiled by authors in 2016)

State	Tons per day
Mexico City	16,486.55
Mexico State	13,014.29
Jalisco	6.944.16
Veracruz	6030.15
Puebla	4330.25
Michoacán	4187.8
Nuevo León	4042.19

Table 6.2 Wastes type in Mexico 2012 (SEMARNAT 2014 & compiled by authors, 2016)

Wastes type	Thousands of Tons, 2012	Percentage
Paper and cardboard	5822.82	13.83%
Textile	602.06	1.43%
Plastics	4584.99	10.89%
Glasses	2475.66	5.88%
Metals: aluminium	728.38	1.73%
Other metals	719.87	1.71%
Food, garden and other organic waste	22,070.27	52.42%
Disposables	5098.7	12.11%
Total	42,102.75	100%

The SEMARNAT informed in 2014 that Puebla occupied the 5th place of USW daily generation in Mexico; there are 31 states and 1 federal district in the country. In Table 6.1, the seven states that generate the most USW in Mexico are indicated.

From the total of 1894.35 miles of tons, 1609.45 are casted in controlled places (landfills) and 284.9 are casted in no controlled places and used for recycling processes. In average, every year, the urban solid wastes quantity in Puebla increases 2.91% for the last 10 years, in comparison with the 2.78% national average (SEMARNAT 2012a, b).

The above indicator is an important element of analysis, since it points out that there is great to do with the USR management in Puebla, specifically for the recycling part. Few statistics on the waste composition can be found, one of the latest (2012) is displayed in Table 6.2. This type of information is relevant in order to define what waste streams are potentially suitable for either any or the combination of the 3Rs (CE tenets). Table 6.2 shows that aside from the organic waste, more than 30% of the wastes in Mexico come from materials than can be recycled, e.g. paper, cardboard and glass.

Also relevant to say is that in 2011, paper and cardboard were the first recycled materials in the country (42%), followed by glass products 29%) and plastics (28%) (SEMARNAT 2014).

6.4 Cuautlancingo Case Description

Cuautlancingo Township is located in the west central part of the Puebla state, with 79,089 inhabitants (National Institute of Statistics and Geography 2010). The municipality is bordered on the north by the state of Tlaxcala, the south with the municipalities of San Pedro Cholula and Puebla, the east with the municipalities of Tlaxcala and Puebla and the West with the municipality of Coronango.

The state of Puebla has 16 federal districts, and Cuautlancingo is located in the number 10 with centralised management in San Pedro Cholula.

Cuautlancingo has an area of 3317 square kilometres. With a location in the Southern part of the Valley of Puebla, it has a flat topography and a few steep declines towards the Atoyac River, which is one of the most important watersheds in the state. It has three counties: La Trinidad Santorum, La Trinidad Chautenco and San Lorenzo Almecatla (INAFED 2015).

The selection of Cuautlancingo for this research was based on the presence of one of the most important industrial parks in Puebla (Finsa) with around 24 companies, including Volkswagen (Finsa 2015). Besides, the municipality has a solid waste management under the circular economy.

6.5 Methodology

The methodology used is of qualitative nature, and this is here further described in this section to explain how the information was obtained and analysed. The main stages to gather the information were (1) asking the municipality staff for interviews, (2) questionnaire design, (3) semi-structured interviews application, (4) analysis of information, (5) additional meeting to clarify questions with the people interviewed from the municipality and (6) a preliminary report ("*As Is*" *process mapping*[2]*)* elaborated, to be further developed and finalised later on.

As here above-mentioned, interviews with the governmental authorities responsible of the environment policy were carried out at different stages of this research and with different purposes. The first one had an exploratory character with the purpose to learn about the urban solid waste generation and its management. From this meeting, it was identified that the urban solid waste treatment is one of the main concerns of the municipality and that the local government has no solid waste management system at all. Because of this, the processes during the waste collection, separation and disposal are not well defined yet, and it is seen as an opportunity area. Hence, the main focus of the diagnosis was on the nonhazardous-inorganic solid waste treatment to delimit the scope of this research.

[2] The "*As Is*" diagram describes the present state of the organisation's process, culture and capabilities. The main purpose is to help to identify where the improvements areas are as potential starting points.

In order to perform the preliminary diagnosis, it was required to describe a set of questions to gather information from the Cuautlancingo municipality. In the second meeting, this questionnaire was personally applied not only to the head of the environmental department but also to the environmental council. The involvement of different waste operation areas provided an enriched variety of responses at that moment. The information was put together in order to be classified and analysed based on each process and on the way solid wastes could be recycled, reused or disposed. The information was also assigned for a further analysis focused on some other components to be considered in a circular economy (CE) loop.

By the time the first set of information was analysed, it was necessary to perform a check-up to exclude any potential misunderstanding and to clarify the issues that could be arisen during the information analysis stage. This action took place during one more meeting with the presence of multi-actors: the mayor of Cuautlancingo, the environmental council, the head of the environmental department and the waste operations department head. During this meeting, some more pieces of information were provided under request to round up the information that created a better understanding of prior inputs.

Based on the information provided, it was possible to identify the "*As Is process mapping*" to obtain a general idea on how many steps and interfaces are presented along the process of recollection, segregation and waste disposal.

6.6 CE Practices Application in Cuautlancingo Municipality

From the interviews and meetings with the local authorities of Cuautlancingo, in particular the one with the environmental councillor, several policy goals were mentioned regarding the implementation of concepts such as environmental and social sustainability. Circular economy was not per se named, but the CE tenets associated with waste management and economic and social value creation were clearly indicated. Even further, sustainability was regarded as the welfare improvement of the Cuautlancingo community (families and businesses). The plans and projects associated with the circular economy principles applied to the solid waste management founded are the collection of separated wastes; the recycled actions, awards and public recognition for companies that are socially responsible and care about the environment and territorial reserve; educative campaigns to increase environmental awareness; dissemination of best practices; etc. In a more descriptive manner, the plans and projects are described in the following sections.

6.6.1 Separated Waste Collection

The local government has six collection trucks, and they collect three times per week the municipal nonhazardous wastes, except for the Volkswagen plant and the industrial Park Finsa, because such industries hire private companies for the same purpose.

The homes and stores are responsible for the in situ first separation of organic and inorganic materials. As for the inorganic portion, several materials need to be separated according to their reintegration possibilities to the market; the materials are cardboard, glass, polyethylene terephthalate (PET) and cans (aluminium). Every Tuesday, Thursday and Saturday, the trucks collect those materials and drive them to the Panotla landfill, in the state of Tlaxcala.

In a monthly basis, 1.0 ton of cardboard, 1.5 tons of PET, 0.5 ton of glass and 0.3 ton of aluminium are collected. The costs related to the collection activities sum up to the amount of 2659.26 USD per truck, including the driver salary, gas and maintenance. This information is resumed in Table 6.3, and the monetary calculations were based on a currency exchange rate of 18.00 MXN/USD.

6.6.2 Actions of Recycling

From the collected materials, only 16% of each type is actually recycled; the rest are mixed with other wastes when they arrive to the landfill. The persons who live in the surroundings pick up the wastes, clean them and sell them to a third "actor" for their reuse. They can sell them per ton unit as follows: cardboard $60.60 USD[3]/ton, PET $260.60 USD/ton, glass $18.18 USD/ton and aluminium $909 USD/ton.

If the local government would take the responsibility to organise the recycling of the here above-mentioned materials, this would represent an additional income for the local administration. Table 6.4 shows some monthly estimations done at this regard if the municipality decided to sell directly those collected materials.

The geographical domain of the Cuautlancingo municipality includes an ecological park whose name is "El Ameyal". The park's surface corresponds to 7 hect-

Table 6.3 Collected materials and associated monthly costs (Authors contribution)

Product	Cardboard	PET	Glass	Can
Quantity collected tons/month	1	1.5	0.500	0.300
Payroll USD per 6 trucks/month	$1600			
Gas USD per 6 trucks/month	$8800			
Maintenance/month USD	$5555			

[3]All the currency conversions from Mexican (MXN) pesos to USD were done with the 18.00 MXN/USD exchange rate.

Table 6.4 Potential income according to sales percentage

Product	Carton	PET	Glass	Can	Total USD
Selling 16%	$9.69	$62.54	$1.45	$43.63	$117.31
Selling 50%	$30.30	$195.45	$4.545	$136.35	$366.64
Selling 100%	$60.60	$390.90	$9.09	$272.7	$733.29

Table 6.5 "The Ameyal Park" wastes management 2014–2015 (Adapted from Cuautlancingo municipality 2015)

2014		July 2015		
Wastes	Total (tons)	Wastes	Total (tons)	Total (tons)
Pet (1)	217.5	Pet (1)	348	565.5
Carton	121.5	Carton	78	199.5
Glass	136	Glass	130.9	266.9
Can	19.5	Can	22.5	42
Aluminium	23.5	Aluminium	15.1	38.6
Others	270.8	Others	52.8	323.6
Organic	65.8	Organic	50	115.8
Recycled	**885.7**	**Recycled**	**697.3**	**1583**
Waste	**1371**	**Waste**	**2001.20**	**3372.20**
Total	**2256.70**	**Total**	**2698.50**	**4955.20**

ares with some facilities such as 600 lineal metres track, exposition centre, children's playground, picnic area and theatre. The government of Puebla donated 160 trees to the park, and Volkswagen supported the planting of more than 1000 trees in the park's green areas. The Volkswagen's executives participated in those activities who also donated pumping and watering equipment for tree maintenances. Additionally, they provided trash cans for the park.

The urban solid wastes management in the park began in August 2014. They had from the beginning a strict weight control of each type of generated waste. Some of them are displayed in Table 6.5.

All the materials are stored in the recycling park storehouse for their sell at the end of the year to a recycling company.

Additionally, the local government has an agreement with the Autonomous University of Puebla (BUAP) that consists in collecting the organic wastes and leaf litter, from the Ameyal Park, to produce fertiliser.

6.6.3 Awards and Public Recognition and Territorial Reserve

The local government of Cuautlancingo awards and recognises the companies that are socially responsible and care about the environment; some of the awarded actions are directly related to the CE perspective. For instance, in April 2015, some schools were awarded because of their projects associated with materials recycling

and environmental care. The award is called “Clean School” and is given to the 71 Technical School and The Gabriel Alatriste Junior High School, both located at San Lorenzo Almecatla municipality. These schools produced fertiliser with their own organic waste and with recycled cardboard handcrafted little home’s souvenirs, palapas[4] and school supplies. As an incentive, the students received backpacks and football balls for their important contribution.

Furthermore, the City Inn Hotel carries out sustainable actions by using recycled flatware and the “Elektro Controles y Motores de Puebla” company recycled the wastes making objects for internal use.

Cuautlancingo invested 4.375 million dollars in a territorial reserve called Quetzalcoatl-Chautenco, 1.25 million in land and 3.125 million in infrastructure. This reserve includes terraces, the Ameyal Park, a wealth centre and other services that provide support to the community. The management of the reserve relies on its own inspection office that helps for organising and planning all the services.

6.6.4 Workshops to Increase Environmental Awareness

The municipality of Cuautlancingo considers very important to raise awareness and educate the population about circular economy principles and its implementation and benefits. Therefore from 2015, the authorities delivered free workshops in their facilities on how to separate wastes, to recognise responsible products, to produce fertilisers and to construct vegetable gardens. The number of attendees in 2015 was 497 people, expecting to receive more each year.

6.6.5 Upcoming Projects

Because the municipality of Cuautlancingo doesn’t have a centre to transfer the wastes where the USW can be casted after collection, the construction of one is in the municipality planning. The local authorities have met several times and came up with the plan to invest 25,000 USD in the transfer centre facilities. The objective is to create an inter-municipality landfill with the intervention of nine municipalities and to run it with renewable energy sources. With such project in mind, the savings could reach 30% of the cost for each municipality involved. The purpose is to have a space where the transporters can carry on the wastes and separate them for their respective uses.

[4] Palapa is an open-sided dwelling with a thatched roof made of dried palm leaves. It is very useful in hot weather and in the coast of Mexico.

6.6.6 *Best Practice: Volkswagen*

As a best practice to be followed by the local government or other companies, Volkswagen company was visited in order to learn about its activities related to circular economy and sustainable processes for the USR management. The company, which is certified as "socially responsible", operates based on an environmental performance that includes materials recycling, water treatment and renewable energies. The company "Think Blue" project targets all those aspects together to contribute to the environmental improvement, also by considering the people awareness on their well-being standards. The Think Blue strategy is shown in Table 6.6.

In 2014, the environmental benefits attributable to the "Think Blue Project" can be here summarised in three main aspects: (1) the use of energy decreased 19% in comparison with 2010, (2) the water consumption reduced 9% and (3) the waste generation was reduced 96% compared to 2010. In addition to that, the carbon dioxide decreased 16% in the same period. (Volkswagen plant 2015).

Table 6.6 Think Blue strategy (Adapted from Volkswagen 2015)

Products and solutions	Ecologic awareness	Cooperation and initiatives
Blue motion technologies	Education	Think Blue nature
TSI & DSG	Visits to universities	"Itza-popo" project
Turbo diesel	Environmental education	"Sierra de Lobos"
Hybrids		"For love to the planet"
Electrics		
Think Blue finance		
Think Blue factory	Training	New projects
Sustainable production	Training and technical advice to employees	Tire recycling
		New water treatment plant
		Technical-social projects with sustainable technology
		Eolic project park
	Diffusion/communication	
	Newspaper, magazines	
	Switch information with other assemblers	
	Diffusion with local and national media	
	Reports about sustainability	
	Environmental ideas	
	Tips for saving energy	

6.7 Conclusions

Based on the evidence gathered during this research, it can be said that the government of Cuautlancingo cares about its environment and performs actions to contribute to the welfare and quality of life of the community. The services delivered by the municipality have a direct effect on the local environment. Drinking water, domestic drainage, waste disposal, wastewater treatment, hygiene and cleanliness of marketplaces and other services are today's challenges of Cuautlancingo. In addition to that, the urban solid wastes management in Cuautlancingo is lagging behind when comparing it with what circular economy promotes. Consequently, it is convenient that the municipality redesigns processes and offers products and services more aligned to the circular economy tenets that can bring additional income.

Even further, investing in greening can generate employment and sustainable supply chains for the products. The more companies recycle and reuse the USW, the higher productivity level of the municipality can be achieved. Furthermore, based on the leader companies' best practices, other local governments and companies may benchmark and adjust such practices to implement actions that lead to a waste management efficiently.

The authors suggest that Cuautlancingo continues registering and analysing indicators in order to assess circular economy in a more accurate way. Some indicators that can measure the progress of the greening of sectors are the resource consumption rate (per capita), the waste generation rates and how much of it is segregated and recycled and the proportion of waste used for energy recovery.

To further promote the circular economy, the local government shows willingness to work hard to formulate regulations and policies in order to ensure the environmental care and responsible acting of the citizens. It is very important that Cuautlancingo continues working with the environmental education campaigns and with the awareness of the wastes management opportunities for the community.

As a reflection on the way this research was carried out, the authors noticed that the government officers are interested in this kind of grouping work where stakeholders meet to discuss all the needed key aspects in benefit of the city. They often showed an enthusiastic and cooperative attitude in order to answer the questionnaire applied and were conscious that there is still so much to improve in the solid residues management, especially in the recollection phase.

The future research work of this paper could compare the USW management of some other municipalities with similar characteristics as Cuautlancingo, for instance, with an industrial park or the same population, all that with the intention to analyse the possible generalisation of the findings of this study in point. The contextual conditions would need also to be further described in case comparison among different political entities takes place. This implies the review of this case study if there were some respective new initiatives of laws in Puebla (state).

6.7.1 Social, Economic and Environmental Implications

The present social conditions of the municipality are becoming more favourable in benefit of its population, with a clean and organised city and a better quality of life, and the relations between people, small business and companies can improve and contribute in the sustainability of the specific location. The most important element in one economy or cluster are the people, and with acceptable social conditions, they can act in a better way.

It is important that the local government continues implementing incentives for those companies that do something for the environmental care. Local governments can reform their laws in order to reduce either the taxes or the operating permissions costs for companies. Their focus should be on some alarming environmental threats are ozone layer depletion, atmospheric pollution, natural species extinction, acid rain and desertification (Navarro, 2013).

Cost recovery from improved waste management and avoided environmental and health costs can help to reduce the financial pressure on governments. Private sector participation can also significantly reduce the costs as well as enhance service delivery. Micro-financing, other innovative financing mechanism and international development assistance may in addition be tapped to support operational costs for waste treatment. Finally, a range of economic instruments can serve as incentives to green the sectors, and their implementation could be combined with regulations to set a minimum of safety standards to protect labour conditions.

References

Carrillo G, Constantino T, Roberto, Roldán, Alejandra H (2010) Incentivos de la política ambiental para ecología industrial en México. Innovación y ecología industrial. http://docplayer.es/10729896-Incentivos-de-la-politica-ambiental-para-ecologia-industrial-en-mexico.html. Accessed 12 Aug 2015

Countrymeters.info (2015) Población mundial. http://countrymeters.info/es/World. Accessed 23 Sept 2015

Ellen MacArthur Foundation (2013) Towards the Circular Economy: an economic and business rationale for an accelerated transition. http://www.ellenmacarthurfoundation.org/business/reports/ce2012. Accessed 19 Aug 2016

Federalism and Municipality Development National Institute (Instituto Nacional para el Federalismo y Desarrollo Municipal INAFED) (2015) Encyclopedia of the municipalities of Mexico. Cuautlancingo. http://www.inafed.gob.mx/work/enciclopedia/EMM21puebla/municipios/21041a.html. Accessed 2 May 2015

Finsa (2015) FINSA copyright. http://www.finsa.net/?parques=finsa-puebla. Accessed 2 May 2015

Green Gain (2016) Circular economy. http://www.greengain.co.uk/circular-economy.html. Accessed 10 Sept 2016

Gregson N, Crang M, Fuller S, Holmes H (2015) Interrogating the circular economy: the moral economy of resource recovery in the EU. Econ Soc 44(2):218–243. http://www.tandfonline.com/doi/full/10.1080/03085147.2015.1013353 Accessed 7 July 2015

Mantra (n.d.) RESIDUOS ORGÁNICOS E INORGÁNICOS. http://www.mantra.com.ar/conteco-logia/organicoseinorganicos.html. Accessed 8 Sept 2015

Navarro GF (2013) Responsabilidad Social Corporativa: Teoría y práctica, 2nd edn. ESIC, Madrid, pp 163–210

Organization for Economic Co-operation and Development (OCDE) (2015) Waste. https://data.oecd.org/waste/municipal-waste.htm. Accessed 11 Aug 2015

Pichardo PI (2009) Responsabilidades municipales en materia municipal. *Convergencia.* ISSN 1405-1435 vol 16 No. 49 Toluca, México

Resource (2015) http://www.resource-event.com/welcome. Accessed 12 Aug 2015

SEMARNAT (2012a) Base de Datos Estadísticos-Badesniarn. Consulta Temática 2012. http://dgeiawf.semarnat.gob.mx:8080/approot/dgeia_mce/html/mce_index.html?De=BADESNIARN. Accessed 3 Aug 2015

SEMARNAT (2012b) Residuos. http://app1.semarnat.gob.mx/dgeia/informe_12/pdf/Cap7_residuos.pdf. Accessed 3 Aug 2016

Shi L, Xing L, Bi J, Zhang B (2006) Circular economy: a new development strategy for sustainable development in China. Available via http://www.webmeets.com/files/papers/ERE/WC3/161/Circular%20Economy%20in%20China.pdf. Accessed 28 June 2015

The General Law for the Prevention and Integral Management of Wastes (2003) Fifth article. Mexico

Volkswagen (2015) http://www.vw.com.mx/es/mundo-volkswagen.html. Accessed 2 May 2015

Yuan Z, Bi J, Moriguichi Y (2006) The circular economy: a new development strategy in China. J Ind Ecol 10:4–8. https://doi.org/10.1162/108819806775545321