

# Chapter 10

## PetStar PET Bottle-to-Bottle Recycling System, a Zero-Waste Circular Economy Business Model



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**Abstract** The lack of environmental awareness in society, especially in developing countries, combined with inefficient waste handling systems, has caused millions of PET bottles to end up in landfills, losing their original value. In the worst cases, the bottles mishandled by consumers enter natural systems generating significant negative externalities such as the pollution of soil and water, with the possibility of reaching the oceans. In general, the plastic recycling industry in undeveloped economies is highly dependent on the participation of a broad social group known as scavengers, whose role is very valuable for the supply chain, although it is performed under very difficult conditions and usually operates as part of the informal economy. Maintaining the sustainability of the three actors involved in the industry—the environment, society and business—requires a different business model in which all actors must participate and produce a more inclusive added value. 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: 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. The PetStar sustainable business model is presented, explaining how it works and how it creates a sustainable cycle that is economically feasible and competitive, environmentally resilient and socially shared among one of the poorest and most informal sectors, the scavenger and collector communities. This paper discusses a model of sustainable recycling that can be replicable in other developing countries where the same problem emerges, as well as how to generate a zero-waste circular value system that can be inclusive, clean, viable and capable of generating shared wealth for the community.

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## 10.1 Introduction

Due to its functionality, resistance, safety and lightweight, the use of PET (polyethylene terephthalate) as packaging (bottles) in the beverage industry boomed in the 1990s, creating an environmental challenge because those bottles need to be responsibly disposed of by the consumer for proper collection and recycling.

Unfortunately, society's lack of environmental awareness, especially in developing countries, combined with inefficient waste handling systems, has caused millions of bottles to end up in landfills and lose their original value. In the worst cases, the bottles mishandled by consumers enter natural systems generating significant negative externalities, such as the pollution of soil and water, with the possibility of entering the oceans.

Based on these assumptions—is it possible to develop a way to maintain a PET bottle inserted into a permanent circular system, achieving zero waste and an economic viable business model, that creates social and environmental values?

To address this challenge in Mexico, PetStar started in 1995 as a collector of post-consumer PET bottles, installing a broad nationwide collection infrastructure, and has been buying the PET bottles in bulk format directly from the scavengers. At that time, most of the PET bottles were recycled and transformed into polyester fibres. The material collected was transported to PetStar's collection plants where it was hand-sorted in conveyor belts and then baled to be shipped to customers in the United States and China. Back then, there was no recycling infrastructure available domestically.

It was not until 2000 that PetStar was exposed to new technologies, which were mainly developed in Europe. Those technologies allowed recycled PET resin to be returned to the bottle production factories to be incorporated in new food-grade bottles within a closed continuum cycle, as recycled content.

With the available technologies approved by the FDA (Food and Drug Administration), PetStar tested balled bottles collected in Mexico that were dirtier than those collected in Europe and came up with the most suitable technologies for the project: (a) an Italian one for grinding and washing and (b) a Swiss one for extrusion and solid stating.

Once the collection infrastructure was developed and the technologies were chosen, the subsequent step was to identify the investors. In 2006 investors were found and the bottle-to-bottle project started. After securing customers and developing the engineering and construction, in 2009 the production of Phase 1 started, with a capacity to produce 20,000 ton/year of food-grade recycled PET resin.

To comply with its commitment with the environment by integrating recycled content into their new PET bottles, in 2011 Arca Continental (49.9% of share), the

second largest Coca-Cola bottler in Latin America, bought PetStar. The group of shareholders grew when other Coca-Cola Mexican bottling companies joined Arca Continental, including *Coca-Cola de Mexico* (30%), *Bepensa Bebidas* (10%), *Corporacion del Fuerte* (5%), *Corporación Rica* (2.2%), *Grupo Embotellador Nayar* (1.9%) and *Embotelladora de Colima* (1%). Their shareholding structure is proportional to their market share, so by contractually committing to buy their proportion of food-grade recycled PET resin produced by PetStar, all end up having the same PET recycled content in their new bottles.

The new owners, all part of the Mexican Coca-Cola Industry (MCCI), invested in Phase 2 to expand the capacity to recycle 3.1 billion bottles per year into 50,000 tons of high-quality PET food-grade recycled resin. Production started late in 2013, and PetStar was nominated as “The World’s Largest Food Grade PET Recycling Plant” by “PCI PET Packaging Resin and Recycling, Ltd.” (McGeough 2013).

In the World Economic Forum 2016 (WEF-2016) in Davos, Switzerland, the Ellen MacArthur Foundation (EMF) launched its study “The New Plastics Economy– Rethinking the Future of Plastics”(MacArthur et al. 2016). This was announced with the intention of offering a new vision aligned with the circular economy concept (Webster 2015; EMF 2013) and capturing the current opportunities, as only 14% of the global plastic packaging produced was collected for recycling, from which just 2% was recycled into the same or similar quality application. Ninety-five per cent of the material value (\$80–120 billion/year) of plastic packaging is lost after a short first usage. This situation, in addition to the leakage effects of non-recycled materials, has been causing degradation of the environmental system. Without significant action, by 2050 the ocean may contain more plastic than fish (by weight).

In response to this important challenge, in 2016 PetStar launched its PetStar sustainable business model (PSBM), reflecting its efforts to become a front-runner and innovative engine in the plastic recycling sector. The PSBM is fully integrated into the value chain of PET bottles, from the direct collection of post-consumer bottles (with scavengers and collectors) all the way to the production of new PET bottles combining virgin raw materials with recycled content. Simultaneously, the PSBM considers circularity in its core business because it promotes local job creation, technological innovation and new products that respond to local markets and engages community members in its operation.

The WEF-2017 was the platform for the EMF to launch a second study: “The New Plastics Economy-Catalysing Action” (MacArthur et al. 2017). In this version, it was mentioned that a global momentum for a fundamental plastic rethink is greater than ever. This report is the first to provide a concrete set of actions to drive the transition from the current 14% of plastic packaging collected globally for recycling to 70%. Such a transition was based on three strategies differentiated per market segment: (1) without fundamental redesign and innovation, about 30% of plastic packaging will never be recycled, (2) for at least 20% of plastic packaging reuse provides an economically attractive opportunity<sup>1</sup>, and (3) with concerted efforts in

<sup>1</sup> In 2016, the MCCI sold 22.5% of its volume in returnable (reusable) PET bottles.

design and after-use processes, recycling would be economically attractive for the remaining 50% of plastic packaging.

The PSBM implemented during 2016 fully matched with six out of a total of seven premises of the catalysing action report (MacArthur et al. 2017). The premise not addressed by the PSBM corresponds to plastic films that do not apply to PetStar's profile.

The PSBM focuses mostly on the strategy (3) as the best approach because it covers both economic attractiveness and an efficient recycling system for PET bottles in closed-circled loops.<sup>2</sup>

This chapter is organised as follows: The first two sections focus on framing the situation of the PET industry in the world and in Mexico. The following section presents a detailed description of the PetStar sustainable business model and the processes the company has implemented to attain international standards and certifications, as well as a high degree of viability on the circularity of its operations. The last section deals with the benefits that the company has been produced to the society, to the environment, as well as to their shareholders. This chapter concludes with some insights about the importance to implement an optimum closed circular bottle-to-bottle cycle, maximising the environmental value of the material.

## 10.2 The Circular Economy Model of the PET Industry

The rethinking of the plastic industry requires a new approach to capture new opportunities based on circularity, new technologies and business models, especially for the packaging subsector (The EMF 2013, 2017).

As mentioned before, a great opportunity lies in how to recover, transform and reuse the large volumes of PET material that today are lost after a short first use and how to make this a profitable and sustainable industry.

Globally the PET used in beverage bottles has a higher recycling rate than any other type of plastic, "but unexpectedly, almost 50% of these containers are not collected for recycling and only 7% is recycled in a closed loop of bottle-to-bottle"; this represents a great opportunity.

What's more, the same study shows that "72% of plastic packaging is not recovered at all". Forty per cent goes to landfill, most often in deplorable conditions of pollution, health and environmental care; and 32% leaks out of the collection system and mostly goes to illegal dumping and/or mismanaged actions.

Finally, 14% of the plastic is sent to an incineration or energy recovering process. Although this is better than dumping, "the process loses the embedded effort, labour and costs needed to produce the finished product, and an over-deployment of this process may create a lock-in effect that may push higher value mechanisms (such as recycling) out of the packaging market".

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<sup>2</sup>In 2016, the PetStar shareholders incorporated an average of 32% of PET recycled content in their bottles, with most of the green bottles at 100%.

All four of these situations are a great and irreversible threat for the planet and need to be converted into opportunities, mainly for developing countries, where these figures are rather dramatic.

In summary, some of the actions that must be taken include:

- (a) How to increment the 14% of the plastic that is collected for recycling
- (b) How to increment the 7% of the PET recycled and insert it into a bottle-to-bottle process
- (c) How to take advantage of the 72% that is not recovered and is dumped into polluted landfills and where the collection system can be improved substantially
- (d) How to reduce the 14% of the plastic sent to incineration and transform it into more valuable resources
- (e) How to redesign the packaging so that it complies with the guidelines for plastics recyclability and does not contain components that are expensive to separate or render the container nonrecyclable
- (f) How to reduce the negative externality of the low costs of oil and, at the same time, decouple plastics from fossil feedstock

Most of the above actions can be solved if a circular economy approach can be applied to convert negative practices into valuable opportunities for firms belonging to the important subsector of packaging in the plastic industry.

### **10.3 The Post-consumer Management of the PET Bottles in Mexico**

Historically there was a void in the legal provisions in Mexico for the management of solid waste, its antecedent existing in the “Ley General del Equilibrio Ecológico y Protección al Ambiente” (General Law of Ecological Equilibrium and Protection to the Environment) as recently as 1988, and it was not until 2003 that the “Ley General para la Prevención y Gestión Integral de los Residuos” (General Law for the Prevention and Integral Management of Residues) was published; however, it considered solid waste from a perspective that led only to the disposal of waste generated by people or businesses and assigned local governments the responsibility of offering clean-up services or the option to award concessions for it. This scenario resulted in the appearance of multiple dumps (many uncontrolled), as well as landfills, where the logic has been to bury all types of waste, both recoverable and nonrecoverable.

Without an adequate legal framework, for decades the integrated attention to the waste and the recycling culture ceased to be promoted, a situation that today persists in most of the population and institutions in Mexico. The separation of recoverable waste from the source was not promoted nor was the shared responsibility addressed until 2006 when changes were introduced to the law in this matter to emphasise shared responsibility and the possibility of valuing the waste to take advantage of it

through recycling (SEMARNAT 2006). Nevertheless, in Mexico it is possible to find valuable efforts to change this reality, as in the case of PET plastic packaging.

In 2002, when the PET collection rate and the recycling infrastructure in Mexico were almost non-existent, the Mexican bottling industry, seeking to increase collection rates to change the path of the chicken and the egg, created and funded “Ecología y Compromiso Empresarial” (Ecology and Industry Commitment) ECOCE (2017) as a nonprofit organisation to: (1) promote and fund the collection of post-consumer PET bottles to create certainty and develop the domestic recycling infrastructure; (2) develop media campaigns and environmental educational programmes to create awareness in consumers and promote better habits for the disposal of residue in society; (3) encourage synergies with different levels of the government to attend specific critical areas of mishandled PET residues, seeking solutions under the criteria of integral handling of solid residues by attacking the root cause; (4) participate and promote legislation and normativity related to solid residues in the waste stream to create legal certainty and viability for domestic collection and recycling; and (5) promote the development of a formal strong recycling industry in Mexico to encourage a domestic market, create formal jobs and establish certainty in the consumption of the material.

In 15 years of existence, ECOCE has been a key player in the development of formal PET recycling in Mexico. In 2016, 425,000 tons of PET bottles were collected representing a 57% collection rate of the 745,000 tons of bottles produced. With a total investment of 339 million dollars, the domestic recycling industry processed 240,000 tons that represent 56.3% of the collected bottles, while the remaining 43.7% was exported mainly to the United States and China.

## 10.4 The PetStar Sustainable Business Model

PetStar’s operation generates a triple positive impact on the social, environmental and economic subsystems of the planet’s natural ecosystem, which is 100% internalised in Mexico and embedded in the PetStar sustainable business model (PSBM).

In the environmental subsystem, in addition to removing the bottles from the surroundings, it contributes to a cleaner environment because, in the process of converting them into PET food-grade recycled resin, it reduces by 78% the greenhouse gas emissions against virgin resin. Since 2016, with a cogeneration project and the use of wind power, it was increased to 87% reduction (PetStar 2016), which is equivalent to removing 3.7 million cars from Mexico City for about 2 days, as shown in Table 10.1. This table presents the impact PetStar has delivered on the mitigation of recycled bottles versus bottles from virgin resources on tons of CO<sub>2</sub>, as well as the percentage the company has been able to recycle and transform.

The positive social impacts are considered in terms of the provision of fair and stable income rates that dignify the conditions of the scavengers who indirectly

**Table 10.1** Amount of CO<sub>2</sub> emission mitigation of Mexico City

Resin	Emissions (tCO <sub>2</sub> e/ton)	Production (ton/year)	Emissions (tCO <sub>2</sub> e)	Mitigation vs Virgin (tCO <sub>2</sub> e)	Mitigation vs Virgin (%)
Virgin	2.330	50,000	116,500		
PetStar 2015	0.661	50,000	33,050	-83,450	72%
PetStar 2016	0.303	50,000	15,150	-101,350	87%
<b>Cars in Mexico City (for PetStar Resin 2016)</b>					
Mitigation vs virgin	101,350	tCO <sub>2</sub> e			
Emissions per car in a year	4.80	tCO <sub>2</sub> e			
Avoided cars per year	21,115	Cars			
Avoided cars per day	7,706,823	Cars			
Cars circulating per day	3,693,351	Cars			
Mitigated days	2.1	Days			
<b>Sources</b>					
Emissions (tCO <sub>2</sub> e/ton)	Assessment of PetStar's Sustainability Performance in 2016 PCI Wood Mackenzie by Helen MacGeough and Pieterjan Van Uytvank				
Emissions per car in a year	"Programa para mejorar la calidad del aire de la Zona Metropolitana de la Ciudad de Mexico 2011-2020" (2011-2020 programme to improve the air quality on the metropolitan area of Mexico City of Mexico City) SEMARNAT y Secretaria de Salud (CDMX y Estado de Mexico)				
Cars circulating per day	"Programa para mejorar la calidad del aire de la Zona Metropolitana de la Ciudad de Mexico 2011-2020" (2011-2020 programme to improve the air quality on the metropolitan area of Mexico City) SEMARNAT y Secretaria de Salud (CDMX y Estado de Mexico)				

work with PetStar through its multiple collection partners. As part of the social commitment towards this community, the company provides training and inclusion initiatives that result in certainty for a highly vulnerable population (Medina and Smith 2013).

One of those initiatives is the project developed in alliance with other civil society organisations (CSO) in the municipality of Chimalhuacan, in the state of Mexico. The project participants created the Integral Development Community Center (IDCC) that enhances opportunities with access to education, food and medical services for 250 children of the scavengers who live in the Tlatel Xochitenco

community. The IDCC's purpose is to provide integral attention in the three fields mentioned above to build and develop life skills into the framework of childhood rights.

For educational purposes and as part of its social responsibility commitment, PetStar installed a Museum Auditorium whose mission is to promote environmental awareness, a recycling culture and the spread of the concept of shared responsibility among society, authorities and the private sector (Porter and Kramer 2011). Every year it receives, free of charge, around 13,000 visitors.

This space is environment friendly, with a system for collecting and treating rainwater, solar panels and a green roof, among other practices that help the environment, and is LEED Platinum certified<sup>3</sup> as a green building, making it the first museum in Latin America to achieve this level of certification.

At the economic subsystem, PetStar is part of the MCCI supply chain. The bottle recycling operation adds value and contributes to the sustainability of the packaging sector. With eight collection plants, one by-product valorisation plant, one recycling plant and multiple collection partners nationwide, PetStar directly employs almost 1000 people and indirectly economic benefits over 24,000 scavengers and collectors.

In congruence with its philosophy of excellence and in an effort to help Mexico comply with the Sustainable Development Goals (SDG) (United Nations 2015), PetStar joined the United Nations Global Compact and the Earth Charter and has the following certifications: ISO 9001, ISO 14001, ISO 22000, ISO 50001, OHSAS 18001, Clean Industry, Socially Responsible Company, Top Companies, Operation Clean Sweep, Clean Transport and Occupational Health and Safety Self-Management Programme.

### ***10.4.1 The Circularity of the PSBM***

The PetStar sustainable business model (PSBM) shown in Fig. 10.1 describes how the structure of PetStar is engaged in the sustainable PET packaging industry. The sustainability principle<sup>4</sup> includes most of the concepts that are embedded by the circular economy mechanisms of the ReSOLVE<sup>5</sup> framework.

From the above PSBM, the company manages four core processes: (a) an inclusive collection system, (b) the collection process, (c) the recycling process and (d) the marketing process. These processes are articulated through a circular economy framework that links all stakeholders with the main objective to attain a zero-plastic leakage and a sustainable region. A detailed description of each process follows.

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<sup>3</sup>Leadership in Energy and Environmental Design.

<sup>4</sup>PetStar's Sustainability Report (2016).

<sup>5</sup>The ReSOLVE framework (regenerate, share, optimise, loop, virtualise, exchange) offers organisations a tool for creating value with circular approaches. Ellen MacArthur Foundation for Circular Economy, UK, 2013.





Fig. 10.1 PetStar sustainable business model (PSBM)

10.4.1.1 Inclusive Collection

PetStar promotes the concept of inclusive collection by participating in the Regional Initiative for Inclusive Recycling (RIIR), which is the main regional platform for the articulation of actions, investment and knowledge with the objective of improving scavengers’ access to the formal recycling market in Latin America and the Caribbean by designing and implementing activities which allow (1) *improving* the socioeconomic situation of scavengers, (2) *facilitating* their access to the formal recycling market and (3) *promoting* the creation of public policies for integrated waste management which include scavengers (IRR 2011).

Through these actions, the RIIR would like scavengers’ work to be recognised and valued by building a platform for multi-sector strategic alliances. These alliances will work as a space for dialog and action, thus increasing coordination capacity at the natural and regional level between the government, the business sector and the recycling organisations.

When the bottles are discarded by consumers, they consequently turn into residues. Those residues start a journey within the diverse solid waste management system locally available. Eventually, in some part of the system, they might be recovered by someone (mainly scavengers or collectors), either in their course (e.g. in a garbage truck, in the streets, in public spaces or at home) or at their final disposal site/landfill. Once the recyclable residue is recovered, the scavenger or collector has the option to sell it to a basic consolidator who, as its name indicates, consolidates the recyclables and commercialises them in the formal or informal recycling markets. This process takes place in many areas and at different scales, depending on the consolidator's location along the network. In Mexico, the rate of PET collection is 57% (ECOCE 2017).

#### 10.4.1.2 Collection Processes

To optimise the collection processes, PetStar's collection division recently developed the PetStar inclusive collection model (PICM) that consists of nine processes that reinforce the robust infrastructure of eight collection plants and one by-product valorisation plant that are geographically distributed at a national level. This infrastructure includes the company's own specialised fleet of 120 trucks to offer a collection service of excellence to almost 1200 basic consolidators<sup>6</sup> called collection partners, offering certainty to around 24,000 scavengers and collectors who are recovering the bottles daily, which translates into a high social value.

The nine PICM processes are the following: (1) collection market intelligence, (2) prospection of the basic consolidator, (3) registration of the collection partner, (4) impeccable recollection to the collection partner, (5) impeccable payment to the collection partner, (6) development of the collection partner, (7) public policies, (8) social entrepreneurship and (9) service satisfaction to the collection partner.

All of the material recycled by PetStar is collected in bulk (loose bottles) format by its collection division, transported with its own bulk trucks to any of the eight collection plants where it is manually sorted by colour, removing some contaminants, and then baled. Eighty per cent of the total volume corresponds to the natural PET colour that is transported to the PetStar recycling plant in Toluca. The remaining 20% of other colours and some other types of plastics are classified in five different streams and transported to the by-product valorisation plant. The latter is also located in Toluca, where material is processed for other applications.

With the intention of demonstrating that recycling can be done in a responsible way (e.g. preventing ocean contamination), the leakage of loose bottles is avoided, from their transportation on the PetStar trucks all the way to the incorporation of the recycled resin in new bottles. Moreover, plastic leakage of bottles, caps, labels, flakes, dust and pellets is prevented.

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<sup>6</sup>Information included in PetStar Internal Report (2016).

### 10.4.1.3 Recycling Processes

All the natural colour PET bales produced by the collection division are delivered to the recycling division that consists of one recycling plant located in the city of Toluca, state of Mexico. The recycling plant has the capacity to convert 65,000 tons per year of bales into 50,000 tons of food-grade recycled PET resin to produce new bottles with recycled content for the MICC. The amount indicated is equivalent to 3.1 billion bottles that could fill 2.4 times the Azteca Soccer Stadium<sup>7</sup> in Mexico.

The recycling processes in the recycling division are very sophisticated because they use state-of-the-art technology. The recycling division consists of three sub-processes: (1) grinding and washing, where the bales are broken and the loose bottles are fed into a very big bin with a conveyor belt that feeds a whole bottle prewash system. Afterwards the bottles are electronically sorted to remove colours and other polymers. When the material arrives at the grinding section, the bottles are cut into small pieces or flakes and go into the float sink tank, where the caps and labels will float while the PET material sinks. As the last operation in this process, they continue into friction washing, where glue and dirt are removed and, finally, the flakes are rinsed and dried to be stored in silos.

The second process corresponds to (2) *extrusion*: the washed flake is fed from the storage silos into the ring extruder where the material is melted, filtered and vacuumed. This latter phase has the purpose of removing humidity and volatiles (purification process) to finally produce amorphous pellets which are translucent, as the molecules are not aligned or disordered.

The third process is called (3) *solid stating*. In this process, the amorphous pellets are conveyed to the top of the 50-meter-high tower where the post-condensation or solid-stating process will take place. In this stage, temperature, pressure and residence time are controlled to provoke the re-polymerisation process. The latter will lengthen and align the molecules, building physical and thermal structure back into the resin, which will block the light, making it opaque. Additionally, the material will finalise its purification to become food-grade recycled PET resin.<sup>8</sup> The final product is stored in silos to await delivery to PetStar's customers.

As part of the recycling process, a series of by-products are generated, like the washed polyolefin flake of caps and labels, and different sorts of PET dusts and chunks that are shipped to the by-product valorisation plant. In the latter, they are processed or upsized into valuable applications, which is very consistent with the circular economy concept that encourages zero-value waste processes, finishing the cycle of waste to landfill<sup>9</sup> by adding value to all the streams of the recycling process (Webster 2015; Scheel 2016).

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<sup>7</sup>Largest stadium in Latin America, with a capacity to seat 87,000 people.

<sup>8</sup>Free of volatiles that could affect health or flavor.

<sup>9</sup>See the concept: Circular economy—an industrial system that is restorative by design on: Towards the Circular Economy. Ellen MacArthur Foundation, 2013.



**Fig. 10.2** How to dispose of plastic bottles properly programme

#### 10.4.1.4 Customers (Market)

The food-grade recycled PET resin is billed to our shareholders who are also our customers and is shipped in hopper trucks to their bottle manufacturing suppliers and stored in their silos. This is followed by the feeding operation to the production lines by blending it at different percentages with virgin resin to finally produce new bottles with recycled content. The recycled content varies from 25%, 35% or 50% in clear bottles and up to a 100% in the case of most green bottles.

The manufacturing process of the new bottles takes place in two stages; the first occurs in the injection plants, where a preform (like a test tube) is produced and transported to the bottler. The second stage is carried out at the bottler's, where it is blown to the shape of the bottle, then filled up, labelled and packed to be distributed in the market.

Afterwards the consumer buys the bottled products in the market place, consumes them and as owner of the packaging, has the choice of putting the bottle into the “virtuous circle” of recycling through the four steps shown in Fig. 10.2: (1) empty, (2) flatten or crush, (3) re-cap and (4) deposit. After being deposited, the recyclable material enters the inclusive collection stage described in Sect. 10.4.1, keeping the flow of material circling indefinitely.

#### 10.4.1.5 Innovation and Continuous Improvement

The engine for the PetStar innovation and continuous improvement model is located at the centre of the graphic element shown in Fig. 10.1. As seen before, there are four main elements within the model, signifying that the entire organisation permanently seeks to improve the processes to generate value systemically. Innovation is promoted by the collaboration of all the personnel in a programme called “Ideas in Action” (Ideas in Action). Through this programme anyone can register improvement ideas, which, according to their feasibility, can be implemented. This is an awarding process that implies that the owner of the implemented idea receives either

a diploma or an economic recognition; the “prize” depends on the idea’s impact level on the company’s objectives.

#### 10.4.1.6 The Circular Economy Framework of PetStar

PetStar is using some of the circular economy EMF, ReSOLVE<sup>10</sup> framework (Webster 2015; Lacy and Rutqvist 2015), “which offers organisations a tool for identifying circular strategies and growth initiatives”, as well as other concepts of circularity applied on other countries (Mathews and Tan 2011). The company uses this framework to leverage the dynamics of the PSBM to take advantage of some of its alternatives—regenerate, share, optimise, loop, virtualisation and exchange—for the current recycling of plastic packaging and link it to the PetStar’s regular activities. For instance:

*Regenerate* Restore materials.

Using transformation processes to regenerate the properties of the PET bottle that has been collected and processed to a food-grade standard and to insert it into a permanent usage system.

PetStar recovers 80,000 tons of post-consumer PET bottles per year, which is equivalent to 70% of the PET its shareholders put on the market and turns them into 50,000 tons of high-quality PET food-grade recycled resin that is reincorporated into new bottles of the Mexican Coca-Cola Industry, the other 30,000 tons corresponding to by-products and small losses of humidity and dirt.

*Optimise* Prolonging product’s use period through closing “almost permanently” the recycling cycle.

The efficient flow of materials through the four main activities of the model (inclusive collection, collection processes, recycling processes and customers/market) constitutes PetStar’s circularising process. With these four activities, the value of the PET bottle is maintained for the longest time possible (ideally, in a permanent way) by reincorporating it into the production of new bottles with recycling content.

In 2016, the PET recycled content rate of PetStar’s shareholders was 32%.

*Optimise* How to achieve a zero-plastic leakage level.

Concerned by the challenge of plastic trash that ends up in the ocean and aligned with the initiative called “Operation Clean Sweep” (ACC and PLASTICS 2017), the PSBM seeks to demonstrate that it is possible to avoid leakage of plastic material along the entire chain (bottles, caps, labels, flakes, dust and pellets) due to its full integration, from the recollection of the bottles all the way to the production of the food-grade recycled PET resin.

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<sup>10</sup>Towards the circular economy, Ellen MacArthur Foundation, 2013.

*Optimise* How to get (and share back) most of the scavenger's network.

The living conditions of the close to 24,000 scavengers around the country<sup>11</sup> who supply the feedstock represent a challenging task to dignify this activity. What's more, to optimise their quality of life and efficiency, PetStar is making several efforts to provide them with certainty through fair price, service on time and punctual payment. Also, PetStar promotes the living, health and education conditions of these people, as well as of their families, especially their small children, translating this into better communities, where they are free to decide where to sell the material collected.

*Optimise* Use renewable energy in its processes.

The plant's cogeneration energy cycle, as well as several systems installed to generate energy under a clean energy cycle, such as wind power, makes the plant a sample of how to reduce energy in the operation.

*Loop* Keeping materials and products in an iterative cycle of incremental value sharing.

PetStar, by means of several incentives, organisational initiatives and programmes with the scavengers and collectors who are part of the network of suppliers for the collection plants, is working on the process of closing the loop by collecting 80,000 tons of bottles, which represent 10.7% of all new bottles sent to the market (ECOCE 2017). At the recycling plant, it produces 50,000 tons of food-grade recycled PET resin that is permanently circling in a closed loop of new bottles.

The by-products are also processed in other streams of recycled materials of added value that enter other applications, such as a polyester-based polyurethane system for the insulation of commercial refrigerators used by the PetStar shareholders in the point of sale, or the polyolefin caps and labels that are processed into a compound that is used as material in new crates for the refillable bottles.

*Exchange* Using alternative materials inputs.

A very important element to boost the circular economy is the adequate design of the products. In this respect, PetStar installed a botelloteca<sup>12</sup> and laboratory<sup>13</sup> to promote full compliance of the PET bottles sent to the market with the guidelines for recyclability defined by the "APR Design® Guide for Plastics Recyclability" (APR 2016) to maximise the value of the material when it is recycled (up cycling) (McDonough and Braungart 2002).

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<sup>11</sup>Data obtained from PetStar Internal Report (2016).

<sup>12</sup>Showroom with samples of all the bottles available in the market.

<sup>13</sup>Equipped to perform the APR test protocols.

### ***10.4.2 The Zero-Plastic Leakage Framework***

The zero-plastic leakage framework and the challenge of avoiding plastic trash in the soil and oceans in alignment with the initiative “Operation Clean Sweep” (ACC and PLASTICS 2017) have been embedded in the core of the PSBM to avoid leakage of plastic material (bottles, caps, labels, flakes, dust and pellets) along the entire value chain system.

### ***10.4.3 The Sustainability Framework***

Sustainability is the core of the PSBM, so to guarantee its long-term viability, all our processes are aligned and focused on maximising *social, environmental and economic* values, contributing from the private sector for Mexico to accomplish the 17 objectives of the Sustainable Development Goals (United Nations 2015).

PetStar operation shares the vision of the MCCI to recover the post-consumer bottles from the environment and recycle them efficiently to convert them once again into new bottles with recycled content, thus internalising 100% the social, environmental and economic values in Mexico by contributing locally to a global challenge.

### ***10.4.4 Social Value***

The social value of PetStar is measured in terms of employment indicators: almost 1000 direct employees and 24,000 indirect jobs represented by scavengers and collectors in the country. Also, considered are the educational programmes implemented within the communities.

The IDCC project developed in alliance with other CSOs in the municipality of Chimalhuacan, state of Mexico, is a clear example of this social effort.

PetStar’s main strength is its human talent, for which internal volunteer programmes have been implemented so that the time and capabilities of all its collaborators can contribute along different specific journeys in the framework of (1) the Global Recycling Day, (2) the Day of the Tree, (3) the Earth Day, (4) the International Day for the Environment and (5) the Day Without Cars. Even further, there are other volunteer programmes to accompany the IDCC children in the celebration of Christmas, which turned out to be a very touching event, organised by the CSO that operates the food service.

The concept of shared responsibility between the society, the public and the private sectors is the only way to face the big challenge of the management and exploitation of the solid residues in Mexico, in which everyone should take its responsibility and do their part (Porter and Kramer 2011).

As part of this shared responsibility scheme, *society as consumers*, when someone buys a bottled product, that person becomes the owner of the purchased product

and its packaging. In the case of PET, after a bottled product is consumed, the owner of the bottle has not only the possibility but the responsibility to initiate the process of recycling in the right way, which PetStar promotes with four steps: (1) empty, (2) flatten, (3) re-cap and (4) dispose of the bottle properly.

In fact, Fig. 10.2 shows a scheme of simple actions that decrease 75% of the packaging volume, making the whole recovery chain more efficient, efficiency that can be translated into an important reduction of the carbon footprint generated by the recyclable residue, as well as the caps that are captured and recycled. In addition, when a citizen performs the four-step scheme in a conscious way, he/she is recognising that the bottle is not trash but a valuable recyclable residue. Furthermore, this attitude shows eagerness to participate to guarantee its circularity.

#### ***10.4.5 Environmental Value***

PetStar's challenging environmental goals for 2020 include (1) neutralising its carbon footprint, (2) neutralising its water footprint, (3) zero-plastic leakage and (4) zero waste. There has been a great evolution towards these goals, since in 2016 we implemented a cogeneration project that decreased the energy consumption in the recycling plant by 15%, plus the use of wind power.

#### ***10.4.6 Economic Value***

Independently of the positive social and environmental impacts for its shareholders, the PSBM generates value to the supply chain of the Coca-Cola bottlers in Mexico; PetStar guarantees its economic viability by maintaining the price competitiveness of its PET recycled resin versus the virgin resin (as it is substituted) under any market condition. Furthermore, it offers a reasonable financial performance to the committed investment.





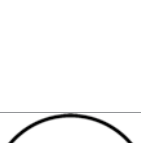
To keep a sustainable model under economic feasibility, a circular economy business model (Lewandowski 2016) is achieved through innovation, efficiency and constant improvement in every process, which maintains an effective circularity and, at the same time, obtains positive economic indicators, aligned to the circularity principles and avoidance of plastic leakage.

#### ***10.4.7 Philosophy of Excellence***

As seen in Fig. 10.1, the PSBM pursues the exercise of its leadership in a very responsible way by promoting sustainable development and the formalisation of the plastic recycling sector in Mexico. In this regard, PetStar seeks to be a reference of excellence at the international level by demonstrating that this activity can be performed with high standards endorsed by its philosophy of excellence (Table 10.2).










**Table 10.2** PetStar's philosophy of excellence credentials

Symbol	Name	Description
	<i>Sustainable Development Goals (SDG)</i>	From the private sector, PetStar seeks to contribute with international commitments that Mexico, as a country, has signed up on. One of them is the commitment to accomplish the 17 Sustainable Development Goals (SDG) of the 2030 Agenda for Sustainable Development (United Nations 2015). Most of the processes included in PetStar's business model point to those targets, as indicated previously
	<i>Earth Charter Initiative</i>	In 2014 PetStar adhered to the Earth Charter Initiative that is an ethical framework to build a just, sustainable, and peaceful global society for the twenty-first century. It seeks to inspire in all people a new sense of global interdependence and shared responsibility for the well-being of all humanity, the greater community of life and future generations. It is a vision of hope and a call for action (The Earth Charter 2008)
	<i>The Global Compact Mexico</i>	In 2016 PetStar adhered to the UN Global Compact in Mexico, which is the world's largest corporate sustainability initiative and a call to companies to align strategies and operations with universal principles on human rights, labour, environment and anti-corruption and take actions that advance societal goals as well (United Nations Global Compact 2004)
	<i>Socially Responsible Company (ESR)</i>	Every year since 2015 PetStar received the "Socially Responsible Company" (CSR in its English acronym) acknowledgement granted by CEMEFI (Centro Mexicano para la Filantropía) as well as its affiliation to the "ESR del 1% de inversión social" (Socially Responsible Company of the 1% of social investment) meaning that at least 1% of profit before taxes will be donated to any social cause and contribute to a more just society and a better country, and starting in 2016 it engaged in the programme "ESR Comprometidas en favor de la inclusión social" (Socially Responsible Companies committed in favour of social inclusion) (CEMEFI 1994)
	<i>Top Companies</i>	Every year since 2015 PetStar measures its organisational culture through Top Companies, which is an external Mexican consultant who shares the results with Grupo Editorial Expansion. This publishes the ranking as Super Empresas Expansion (Expansión 2016), which refers to "the place where everybody wants to work", achieving in 2015 the 44th place of companies in the category of 500 to 3000 employees and in 2016 climbed to the 41st place




(continued)

**Table 10.2** (continued)

Symbol	Name	Description
	<i>Clean Transportation</i>	For the good environmental performance of its fleet of trucks in 2016 PetStar achieved registration in the Clean Transport Programme granted by SEMARNAT (Secretaría del Medio Ambiente y Recursos Naturales) (SEMARNAT n.d.)
	<i>Operation Clean Sweep (OCS)</i>	Since 2015 PetStar embraced the “Operation Clean Sweep” (OCS) initiative (ACC and PLASTICS 2017), an international programme designed to prevent resin pellet, flake, and powder loss to help keep this material out of the marine environment.
	<i>LEED Platinum</i>	In 2015, the PetStar Museum Auditorium located in the recycling plant in Toluca achieved the LEED (Leadership in Energy and Environmental Design) Platinum certification awarded by the US Green Building Council as a sustainable building, becoming the first museum in Latin America to achieve this level of certification
	<i>Clean Industry</i>	Every year since 2015 the recycling plant in Toluca achieved the distinction of Clean Industry at a federal level granted by PROFEPA (Procuraduría federal de Protección al Ambiente), as well as clean industry at the state level granted by PROPAEM (Procuraduría de Protección al Ambiente del Estado de México)
	<i>PASST</i>	In 2016 PetStar signed an agreement with STPS (Secretaria del Trabajo y Previsión Social) to incorporate voluntarily all its plants into “Self-Management Programme in Health and Safety at Work”. In 2016, the collection plants in San Luis Potosi, Merida, Monterrey, Acapulco and Guadalajara were certified and in 2017 the collection plants in Toluca, Ecatepec and Queretaro, as well as the by-product valorisation plant and the recycling plant, both in Toluca, will be certified
	<i>ISO 9001</i>	In 2014, the recycling plant in Toluca achieved the ISO 9001 certification, then in 2015 the collection plant in Ecatepec and finally in 2016 all other seven collection plants, as well as the by-product valorisation plant
	<i>ISO 14001</i>	In 2015, the recycling plant in Toluca obtained the ISO 14001 certification, and in 2017 the eight collection plants and the by-product valorisation plant will be certified

(continued)

**Table 10.2** (continued)

Symbol	Name	Description
	<i>ISO 22000</i>	In 2015, the recycling plant in Toluca achieved the ISO 22000 certification. This is very challenging for a recycling plant
	<i>ISO 50001</i>	In 2016, the recycling plant in Toluca achieved the ISO 50001 certification, and in 2017 the eight collection plants and the by-product valorisation plant will be certified
	<i>OHSAS 18001</i>	In 2014, the recycling plant in Toluca achieved the Occupational Health And Safety Standard (OHSAS 18001) certification

#### ***10.4.8 PetStar's Mission, Vision and Values***

Based on the above framework, the company has stated its mission, vision and values.

The mission has been oriented to promote the preservation of the environment in benefit of future generations by implementing innovative solutions that make the PET bottle sustainable, with efficient collection and recycling to produce high-quality PET food-grade recycled resin with social responsibility.

The company's vision is to become a worldwide reference of excellence through the inclusive recycling of the PET bottle that with talent, commitment, innovation and well-being adds value with social and environmental responsibility to its clients, thus contributing to the solution of climate change.

Values, such as *safety, honesty, responsibility, service, reliability* and *respect*, are internalised in PetStar by living them every day, contributing to global sustainability and respect for the Earth Charter's (The Earth Charter 2008) fundamental principles.

### **10.5 The Sustainable Benefits of PetStar Circular Operation**

Sustainability is the core of the PetStar sustainable business model, so to guarantee its long-term viability, all company processes are aligned and focused on maximising *social, environmental and economic* values, contributing from the private sector

to Mexico to accomplish most of the 17 objectives of the Sustainable Development Goals (United Nations 2015).

PetStar operation shares the vision of the Mexican Coca-Cola industry to recover post-consumer bottles from the environment and recycle them efficiently to convert them once again into new bottles with recycled content, internalising the social, environmental and economic values 100% in Mexico and contributing locally to a global challenge.

In summary, PetStar has implemented a well-planned corporate strategy that supports pursuing the following objectives:

### 1. *Social value*

- (a) Dignifying the labour of scavengers
- (b) Optimising scavengers' living conditions
- (c) Providing fair and stable income to scavengers and collectors
- (d) Giving access to education, food and medical services to the children of scavenger communities
- (e) Promoting the creation of public policies for integrated waste management with the inclusion of scavengers
- (f) Promoting well-being for almost 1000 direct employees
- (g) Creating internal volunteer programmes
- (h) Using the museum auditorium to promote environmental awareness in society

### 2. *Environmental value*

- (a) Recuperate the bottles to prevent pollution of soil and water, as in 2016, when almost 80,000 tons, equivalent to 70% of the bottles that its shareholders sent to the market, were collected.
- (b) Facilitate the sustainability of shareholders' PET packaging, as in 2016, when an average of 32% of PET recycled content was used in their bottles and in most of their green bottles, 100%.
- (c) Drastic CO<sub>2</sub> emission mitigation versus virgin resin (towards neutral carbon footprint for 2020).
- (d) Prevention of plastic leakage of bottles, caps, labels, flakes, dust and pellets in the system (towards zero-plastic leakage for 2020).
- (e) Zero-value waste transformation to valuable assets (towards zero-waste for 2020).
- (f) Use of renewable energy sources.
- (g) Efficient use of water in the process (towards neutral water footprint for 2020).
- (h) Promote the PET Mexican packaging industry to comply with the "APR Design® Guide for Plastics Recyclability" to improve the recycling viability of the bottles in the market.

### 3. *Economic value*

- (a) Guarantee to its shareholders a price for the food-grade recycled PET resin equal or better than virgin under any market condition (such as oil price fluctuation and a balance of supply–demand recycling model).
- (b) Ability to produce 50,000 tons per year of food-grade recycled PET resin with an installed capacity of 40,000 tons per year.
- (c) Profitable operation, as it generated the following EBITDA: 5.6% in 2014, 11.2% in 2015 and 15.6% in 2016.

## 10.6 Conclusions

The recycling industry exhibits the win-win-win properties of sustainable growth, generating employment social equity and being enviro-friendly; but the trade-offs are considerable in combining these aims. (UNIDO 2015)

Solid waste management in developing countries today is threatened by several negative externalities, the society’s poor sustainable culture, the deficient infrastructures, the informal economy where the scavengers operate, their low levels of human development, non-operable or lack of public policies, the astronomical volume of residues generated and unmanaged by the public services, the huge loss of value by burying the residues in landfills and the inability to contain the leakage to natural ecosystems, contaminating soil and water.

The factors that create a challenging reality to the plastic packaging recycling industry, in addition to its own threat of lower oil price and the light weight of the material, make this industry a great focus of interest for entrepreneurs, environmentalists and innovators, looking for better ways to attack such negative issues and convert these externalities affecting a low-profile industry into a sustainable business.

One of the innovation practices currently used to attack the above mentioned threats is a correct implementation of circular techniques. The term “waste is food” coined by McDonough and Braungart (2002) summarises the circular approach, and in industries like plastic packing, this concept acquires significant meaning, given the large volume of residues that today pollute the planet.

PetStar has been able to close the loop by optimising resources and applying non-usual activities that link the scavengers (suppliers of feedstock) to the final product in a win-win process. The company has developed a programme of inclusion of the scavenger community for better education, health and living conditions. In the long term, this activity will reward the whole society with social, environmental and economic benefits.

Design for circularity is a key principle of the circular economy approach, and for this purpose PetStar has developed an infrastructure to analyse the technical specifications of the available bottles and all their components, like material, labels, caps, glues, barriers, etc., compare them to the APR Design® Guide for Plastics

Recyclability and offer alternatives to the bottle manufacturers and marketing departments to make sure that all the bottles available in the market are in full compliance, maximising their potential value when they are recycled.

With the implementation of the PetStar sustainable business model, the company wants to demonstrate that recycling is the path to the sustainability of plastic packaging, specifically for the PET bottle in a closed loop bottle-to-bottle cycle. By doing this with very high standards in processes and management, under the framework of its philosophy of excellence, the company wants to break with the paradigm that recycling is a dirty, low-quality, high-risk activity. On the contrary, PetStar is a very clean, high-quality, safe process with world-class certifications and recognition, translating into a profitable business that generates social, environmental and economic values.

Another important conclusion is PetStar's ability to optimise the number of cycles a bottle can have to close the loop and minimise the use of petrochemical components, as one of the alternatives to decoupling plastics from fossil feedstock, maximising the environmental value of the material.

The main lesson learned from this chapter is how to run a company that can close the sustainability cycle, upgrade social inclusion and achieve a zero-waste to landfill approach by optimising the recovery of PET bottles and, at the same time, be economically feasible and competitive.

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