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## **FROM FLOW TO STOCK. NEW CIRCULAR BUSINESS MODELS FOR INTEGRATED SYSTEMS: A CASE STUDY ON REUSABLE PLASTIC CUPS\***

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### **Abstract**

In recent years, the Circular Economy paradigm has gained its momentum among researchers, practitioners and policy-makers. The Circular Economy is underpinned by the transition towards renewable energy sources and circular business models following three simple principles: design out of waste and pollution, keep products and materials in use and regenerate natural systems. Such a framework needs new business applications to face the challenge on materials’ transition (i.e. from single use to reuse). In this paper, an innovative business model for an urban integrated system is described - aiming at transforming material flows into material stocks. The model allows private companies (food and drink providers) to reduce the usage of single-use products and the amount of exploited raw materials. A pilot project, focused on the reduction of single-use plastic cups, is discussed; the business model is based on a service company which introduced a Deposit-Return System (DRS) for reusable plastic cups within the urban area of the City of Turin. The integrated system aims at reducing the splitting of the material, i.e. the plastic cups, flow by aggregating them into a new material stock. Results from one survey, related to the consumers’ behaviour, from a BM Canvas and from the Material Money Flow are presented, highlighting pros and cons.

*Keywords:* circular economy, reuse, material flow analysis, single-use plastic, business model

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## **1. Introduction**

The ubiquity of plastic in our everyday life and in any industrial process and commercial product is unequivocal. Plastic is a very versatile material which has contributed, and is contributing, to many product innovations. Indeed, plastic production is constantly growing since the '60s and it reached a global production of 335 Mt in 2016 (Plastics Europe, 2017). However, inefficient and flawed plastic waste management ends in impactful consequence on environment. Plastic leakages, i.e. plastics dispersed into the environment, sooner or later, end up into the oceans. Currently, 150 Mt of plastic is the amount estimated to lie in the oceans (World Economic Forum, 2016) and, every year, more than 8 Mt may arrive to the seas. Littering and plastic leakages into oceans are becoming a global emergency due to the slow degradation and to the so-called microplastics (Li et al, 2016) which enter into the food chain of fishes (do Sul et al., 2014), birds (Tanaka et al., 2013) and humans (Li et al., 2016; Wright et al., 2017), causing premature animals deaths. Generally, plastics are fossil-fuel based and energy recovery is a common practice due to the high energy bonded into the chemical structure. Unfortunately, incineration, or landfilling, plastic waste generates a large amount of greenhouse gas (GHG) emissions and, moreover, plastic materials exit from a circular supply chain and cannot be recycled again as a secondary raw materials.

Despite the huge effort of practitioners and academic researchers in investigating innovative solutions to increase plastic recycling efficiency, as well as the commitment of policy-makers to adopt new policies and strategies (European Commission, 2015a; European Parliament, 2019), the Recycling Rate (RR) in European Union (EU) is still far to be considered satisfactory with an average percentage lower than the 50% in EU28 (Plastics Europe, 2017) and a target for Packaging Recycling Rate of 75% by 2030 (European Commission, 2019a). It is clear that the over-production, and the over-consumption, of plastic products cannot be solved simply by improving the Recycling Rate. Indeed, the single-use plastics constitute the largest part of plastic production, and in 2016 plastic packaging reached nearly the 40% of the global production (Plastics Europe, 2017). New and innovative Business Models (BMs) have to be introduced in order to face the plastic emergency and to reduce environmental impacts by adopting Circular BM improving the reuse and the reduction of single-use plastic usage.

## **2. Circular Economy: the future-proof economic paradigm**

In order to facilitate an effective circular economy understanding, the current industrial-economic system can be questioned first. The current economic paradigm is designed along what can be defined a linear sequence of "take-make-use-dispose" (Moreno et al., 2016), based on the exploitation of natural resources (exhaustible) and on the dispose of products at the end of life. This model has guaranteed well-being and prosperity until now but has, at the same time, generated relevant impacts both from an environmental and a social point of view. First, climate change is a matter of fact: the raise of global temperatures will have noteworthy impacts on human activities and on natural ecosystems generating economic damages, desertification and agricultural productivity decrease, as well as threat to food security and human health (Commoner, 1971; IPCC, 2018, 2019; Lafakis et al., 2019). Moreover, in the current (linear) economic model, the exploitation of natural resources to drive economic activities leads to more than 11bn tons of waste annually worldwide and over 50% of Green House Gas emissions are related to virgin materials management activities - extraction, manufacturing, transportation and disposal (OECD, 2018). On average, Europeans are consuming materials and resources at twice the speed the Planet can

regenerate them (European Environmental Bureau, 2017); as a consequence, resources are becoming more expensive, due to their scarcity, and raw materials extraction is constantly becoming less sustainable (European Commission, 2017; FAO, 2011).

In this context, businesses (-as-usual) across the world are dealing with several risks, such as raw materials price volatility, scarcity of resources and new consumer behaviours. On the contrary, a different economic paradigm, such as the Circular Economy, can mitigate such risks and create economic opportunities (KPMG, 2018). A shift in values and purposes is required for the sustainable transition (Bocken and Short, 2016; Bocken et al., 2018; Ehrenfeld and Hoffman, 2013). To avoid the negative externalities of the linear system, we cannot just “do less bad”, a re-design on how materials and products are produced is necessary in order to decouple the amount of needed natural resources and the negative impacts from the economic development (European Commission, 2018a).

The “Circular Economy” can be the paradigm to tackle environmental issues while boosting competitiveness of companies (European Commission, 2018b); basically, it decouples economic growth from consumption of finite natural resources, by redefining the approach to value creation and natural capital regeneration. As stated by the Ellen MacArthur Foundation (EMF), the circular economy is a new economic paradigm based on three effective principles: i) design out waste and pollution, ii) keep products and materials in use and iii) regenerate natural systems. The new paradigm refers to an industrial framework that is restorative by intention, distinguished into a biological and technical cycles (Ellen MacArthur Foundation, 2013; European Commission, 2019b). For businesses, there are multiple way to implement circular economy principles, depending on the side chosen (biological versus technical) and the inner / outer cycle in which the company’s business model operates. As shown in the butterfly diagram of the EMF, the main scope is to minimise or, even better, eliminate waste in order to make useless waste-to-energy solutions (e.g. incinerators) and landfills, because every single products is designed to be reused, repaired, remanufactured or recycled. The idea of a circular economy is not new. It directly derives from the industrial ecology (Bocken et al., 2016; Jackson, 2009), P). In the 1990s, Robert Ayres introduced the idea of industrial metabolisms defining it as an “*integrated collection of physical processes that convert raw materials and energy, plus labour, into finished products and wastes*” (Ayres, 1994). More recently, McDonough and Braungart (2002) highlighted the necessity to close material loops, divided into “technical” and “biological” type, in a “cradle-to-cradle” economy, rather than cradle-to-grave economy. Moreover, Stahel (2010) discussed the fundamental difference between recycling and reuse, highlighting the importance of the latter one for a circular approach. Especially in the Food system, including packaging industry, the Circular Economy represents a huge opportunity to reconnect business purposes with social values, leveraging on cities as a catalyst for change. The way we currently produce food, and manage the resulting waste, generates significant negative economic, health, and environmental impacts. If nothing changes, by 2050, the food system will have used two thirds of the remaining global carbon budget to keep the world under 1.5°C increase (Ellen MacArthur Foundation, 2019a).

The aim of this paper is to represents an example of a circular Business Model at local level, based on a reuse & redistribute model for cups and drinks in local bars, cafes, exhibitions and events, leveraging on a Product Service System (PSS). In the circular economy framework, Product Service System is a sustainable BM (Tukker, 2015) in which enterprises sell services instead of products and they directly own the products; thus, companies are responsible for the end-of-life of the products (Brezet, 2001; Charter and Tischner, 2001; Manzini and Vezzoli, 2002; Mont, 2004; Tukker and Tischner, 2006a, b). Such business model can improve user experience, optimise logistics and, consequently, lower production and maintenance costs, as well as help businesses to enhance customers brand loyalty and fit products to personal needs (Ellen MacArthur Foundation, 2019b).

The rest of the paper is structured as follows. In Section 2, an overview on European Union normative framework relative on generic packaging, with a focus on Deposit-Return System (DRS). Afterwards, in Section 3, a new Business Model for an integrated DRS for reusable cups is introduced and Results based on a case study are discussed in terms of BM Canvas and Money Material Flow (MMF). Furthermore, results of a survey on consumers relative to single-use versus reusable plastic cups is discussed. Finally, in Section 4, brief concluding remarks with tips, suggestions and barriers relative to the plastic packaging ecosystem are underlined.

### **3. Background**

#### *3.1. Shortly about legislation*

Currently, many Governments (and various relevant Government agencies) are increasingly dealing with the problem of the high use of single-use plastic. For instance, Canada (Walker et al., 2018) and United States (Wagner, 2017) have promoted initiatives aimed at reducing and gradually eliminating single-use plastics. The connection between the use of plastic (especially the disposable one) and the dispersion of waste in the marine environment has been widely demonstrated; research studies highlighted as, only in the coastal countries, from 4.8 to 12.7 million metric tons of plastic waste end their life into the oceans. These numbers are destined to increase progressively by 2025 (Jambeck et al., 2015).

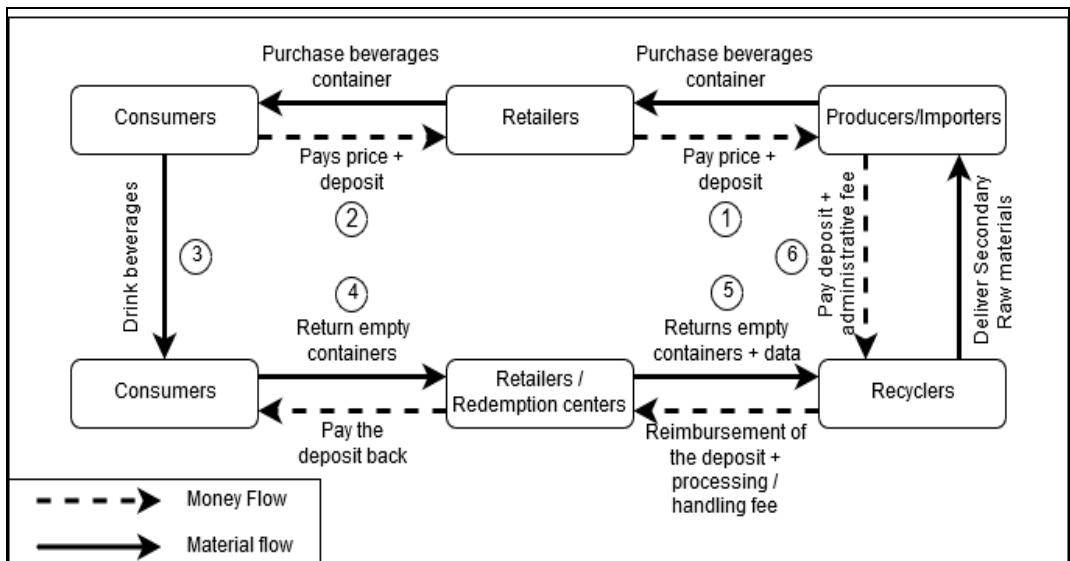
The legislation approved by the European Parliament on 5th June of 2019 (European Parliament, 2019) moves exactly in the same direction, i.e. towards the reduction of single-use plastic components. The European Union had already dealt with these topics with the “European strategy for plastic in the circular economy” declaring that “*a solution must be found for the growing production of plastic waste and for the dispersion of plastic waste in the environment in which we live, particularly in the marine environment*”. The European Union, in order to stem this problem, proposes circular approaches to the use of plastics that give more space to reusable and more sustainable products than those used so far, so as to minimize the amount of plastic waste. For instance, recently, certain products - e.g. plastic straws, single-use plastic cutlery, plastic plates, plastic balloon sticks, cotton bud sticks made of plastic, Oxo-degradable plastics and food containers and expanded polystyrene cups - will no longer be placed on market (European Parliament, 2019). When it will not be possible to stop the use (and the production) of plastic objects, the legislation requires that these be gradually reduced in their use, as well as increasing the proportions of recycled and differentiated plastic waste. Each Member State is free to implement the aforementioned regulations in the most congenial manner, providing that the restrictions are “*proportionate and non-discriminatory*”.

In Italy, the EU legislation has not yet been implemented. Every single region is taking steps to issue and implement legislation on its own behalf. The reference law of the Italian legislation does not aim directly at plastic waste deriving from single-use material but tends to eliminate waste at sea at the end of its life cycle, leaving fishermen “free” to collect the plastic they find in their nets, without having to throw them back into the water (Italian Government, 2019).

#### *3.2. Deposit system background*

In this subsection a brief review on common Deposit-Return Systems for beverage containers is discussed. Currently, worldwide, dozens of countries adopted a DRS with national laws in order to increase the recycling rate of the particular fraction of plastic waste related to the single-use packaging of the food and drink industry (CM Consulting, 2016).

Figure 1 shows a generic DRS for single-use containers. The supply chain starts from the Producers/Importers (1) who sell the filled beverage containers (e.g. water bottle, plastic bottle for soft drinks, beer cans, ...) to the Retailers who pay the price of the drinks plus a little amount of money for the deposit. Afterwards, Consumers buy beverages, paying the deposit to the Retailers (2) and consume the drinks (3). Thanks to the DRS, consequently, Consumers are allowed to bring back the empty containers directly to the Retailers, or to ad-hoc redemption centers or depots, in order to receive back the deposit (4). At this point, the Retailers, who are aggregating packaging in their private spaces, can give back the gathered empty containers to the Recyclers, receiving back the deposit. In addition, the Retailers may provide data information on the recycling rate, the typology of containers and so on (5). In some cases, as in Iceland, the collection of the empty bottles takes place in some dedicated, automated or manual, return facilities. Finally, the Recyclers process the beverage containers such that to obtain secondary raw materials which can be sold again to the Producers/Importers (6). Generally, in centralized system, Producers/Importers, in addition to the deposit, have to pay an administrative fee to the Recyclers or to the private/public organization which manage the waste supply chain. Indeed, in many countries the Recyclers represent both the private actors who proper recycle the materials and a public central organization, a national consortium for instance, who manages the entire deposit system.

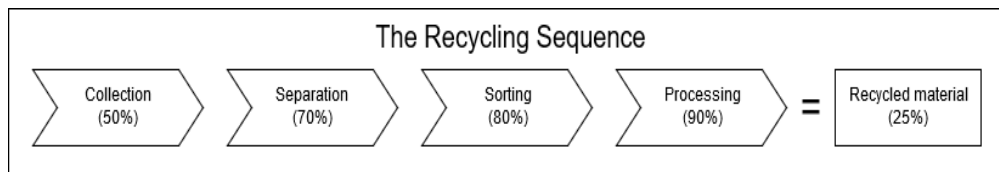


**Fig. 1.** Simplified supply chain of a Deposit System for single-use beverage containers (adapted from CM Consulting , 2016)

The central organization, usually, is responsible for the Clearing System, i.e. it is the entity responsible for the DRS in order to close the money flow. Examples of centralized national system in Europe are the cases of Croatia (Environmental Protection and Efficiency Fund), Denmark (Dansk Retursystem A/S), Estonia (Eesti Pandipakend OÜ) and Finland (Suomen Palautuspakkaus Oy - PALPA). In some cases, the central actor belongs to a few different entities such as the danish Dansk Retursystem A/S, which is a shared property of five organizations - the Dansk Retursystem Holding A/S (85.62%), the Dansk Harboes Bryggeri A/S (14.27%), the Dansk Harboes Bryggeri A/S (14.27%) and the Mineralvandsfabrikken Frem A/S (0.01%) - or, as in the finnish case, PALPA belongs to seven partners - KESKO, Alko, Puotiin, Hartwall, Sinebrychoff, Tuko Logistics, Inex Partners - where each company is specialized in a sector as drink and beverage, alcohol retail

or logistics. In a few cases, there are many organizations (Rhenus Logistics, Interseroh, ...) in a decentralized system, as in Germany, where the Deutsche Pfandsystem GmbH, the system administrator, is owned by the Hauptverband des Deutschen Einzelhandels (HDE) and the Bundesvereinigung der Deutschen Ernährungsindustrie (BVE), a German Retail Association and a German Food Association.

In this framework, the flow is linear up to the Recyclers and there are no financial aid, neither incentive to reduce or reuse products. Indeed, it is straightforward that the material loop is closed only between the Recyclers and the Producers when, effectively, the recovered waste are recycled. As shown in Fig. 2, the recycling sequence consists of, at least, four steps (Graedel, 2011): 1) the *Collection*, acted by the citizens and the municipalities/local multi-utility companies, 2) the *Separation* and 3) the *Sorting*, generally acted by a private-public company, and, finally, 4) the *Processing*, i.e. the effective waste recycling. The whole sequence can be improved only by increasing the efficiency of each step individually; the final efficiency can be computed as a conditional percentage of the four stages. For instance, as exhibited in Fig. 2, the final percentage of recycled material (25%) derives from the 50% of the Collection, the 70% of the Separation, the 80% of the Sorting and the 90% of the Processing processes. The last two steps, Sorting and Processing, completely depends on technology and they can be improved by technological innovation. The second step, Separation, can be improved by technological innovation as well as on the quality of the collected materials, while the first stage, the Collection, primarily depends on the awareness of the citizens and on proper local and national policies, which stimulate the separate collection, such as door-to-door collection (Teerioja et al., 2012), penalties/taxes/incentives (Miranda et al., 1994) or intrinsic reasons for citizens (Aprile and Fiorillo, 2019).



**Fig. 2.** Representation of recycling rate for a generic material reverse supply chain (adapted from Graedel, 2011)

Although the right policies and incentives may improve the efficiency of the Collection process, its efficiency cannot achieve the 100% due to many reasons such as psychological, administrative or logistics barriers; thus, the entire Recycling Sequence will always be affected by an “original sin”. For these reasons, DRSs have been introduced worldwide in the past decades achieving very satisfactory results in terms of recycled materials even if the physical limit of the 100% of recycled material is still very far. For instance, Croatia achieved a total return rate for single-use containers (Plastic, metal, glass) in 2015 up to 90% with a target of 95%, Denmark of 89% in 2014 with a target of 95%, Estonia reached 82.3% in 2015 and Germany 97% in 2014 (CM Consulting, 2016). On the contrary, the European Union Target, according to the Packaging Waste Directive, was 22.5% while the total European Union recycling rate for plastic packaging waste was 40.8% in 2016 (Plastics Europe, 2017). 27.1 Mt of generic plastics was collected over a total production in European Union countries (EU28+NO/CH) of more than 60 Mt of plastics (Plastics Europe, 2017). 8.43 Mt (31.1%) were then recycled, 11.27 Mt (41.6%) incinerated and 7.4 Mt (27.3%) went to landfill. The percentage of collected waste increased by 10.6%, from 24.5 Mt in 2006 to 27.1 Mt in 2016, and the properly recycled increased by 79% in absolute terms, from 4.7 Mt in 2006 to 8.43 Mt in 2016. The percentage of recycled waste,

over the total collected waste, increased from the 19% in 2006 up to the 31.1% in 2016. With respect to plastic packaging the collected waste increased from 14.9 Mt in 2006 to 16.7 Mt in 2016. In the same period, proper recycled plastic packaging increased by 74% and energy recovery by 71%. In 2016, with respect to the total of plastic packaging waste 40.9% were recycled, 38.8% went to incineration while 20.3% to landfill.

Although it is evident the growth of percentage both of collected waste and of recycled waste, it is also straightforward that the efficiency of the collection and the recycling in EU countries can still be noteworthy improved, simply by comparing the percentage of plastic packaging properly recycled with the total return rate obtained by DRS. Table 1 resumes the Total Return Rate within the countries with a Deposit-Return System regulated by a national legislation versus the plastic packaging RR. Indeed, even if the two data are not directly comparable (one refers to collection rate, while the other refers to recycling rate - it is clear that there is a large opportunities of improvement. In fact, a DRS affects the first three stages, Collection, Separation and Sorting, as depicted in Fig. 2. By multiplying the Total Return Rate with the Processing Rate as indicated in Fig. 2, a first insight on the improvement margin can be obtained (Table 1).

**Table 1.** Estimation of Plastic Packaging Recycling Rate from a Deposit-Return System (CM Consulting, 2016) and Countries Recycling Rate (Plastics Europe, 2017)

<i>Country</i>	<i>Total Return Rate (collection + separation + sorting), %</i>	<i>Plastic Packaging Recycling Rate (hp: processing 90%), %</i>	<i>Plastic Packaging Recycling Rate (EUROSTAT)</i>
Germany	97 (2014)	87.3	48.4 (2016)
Sweden	88.25 (2014)	79.2	50.7 (2016)
Estonia	82.3 (2015)	74.1	24.6 (2016)
Denmark	89 (2014)	80.1	36.1 (2016)
Croatia	90 (2015)	81.0	41.1 (2016)
Finland	92.6 (2014)	83.3	25.4 (2016)
Iceland	90 (2013)	81.0	42.7 (2016)
Lithuania	74 (2016)	66.6	74.4 (2016)
Netherlands	95 (2014)	85.5	51.5 (2016)
Norway	96 (2014)	86.4	44.6 (2016)

#### **4. Results and discussion**

A case study, i.e. Plastic Free Movidà (PFM), within the city of Turin in Italy is described as an example for a Circular BM for a Deposit-Return System for reusable cups. This example shows how by introducing a new actor responsible for the Deposit and the Clearing System in the MMF for single-use beverage containers described in Fig. 1 it is possible to transform constant material flow into a temporary material stock.

The PFM Business Model has been introduced by an Italian NGO named greenTO in 2019 within the city of Turin in order to create a distributed and integrated retailers network at urban scale. The BM is based on the adoption of reusable cups by the retailers within an urban area and on a DRS managed by the NGO itself. The definition of “integrated” network refers to the fact that the owner of the reusable cups is a third party stakeholder, in this case the NGO, and the retailers have not to pay any deposit in advance, as in existing DRS for single-use containers and the introduced cups can be delivered back by consumers to any retail involved in the network. The case study is analyzed in terms of MMF and BM Canvas, highlighting the involved stakeholders. Finally, results from a survey on consumers’ behaviour is pointed out.

#### 4.1. Money Material Flow

In this section, the Money Material Flow is described. The DRS here analyzed is pretty similar to the one described in Figure 1 related to the common single-use containers DRS; the main difference is a new actor, i.e. the Deposit Manager Organization (DMO), who is the responsible for the Clearing System and acts as a man in the middle among the Consumers/Retailers and the Producers/Recyclers blocks by managing the Consumer Deposits (Fig. 3). First, the container supply chain again starts from the Producers who sell reusable cups to one, or more, Deposit Manager Organization (1) who purchases directly the empty cups without adding any deposit to the price of the cups. The DMO is the owner of the materials and the manager of the deposits. Second, the DMO delivers the reusable empty cups to the Retailers through private agreement receiving back an *una-tantum* deposit, i.e. a deposit for each requested cup (2) in the first stock.

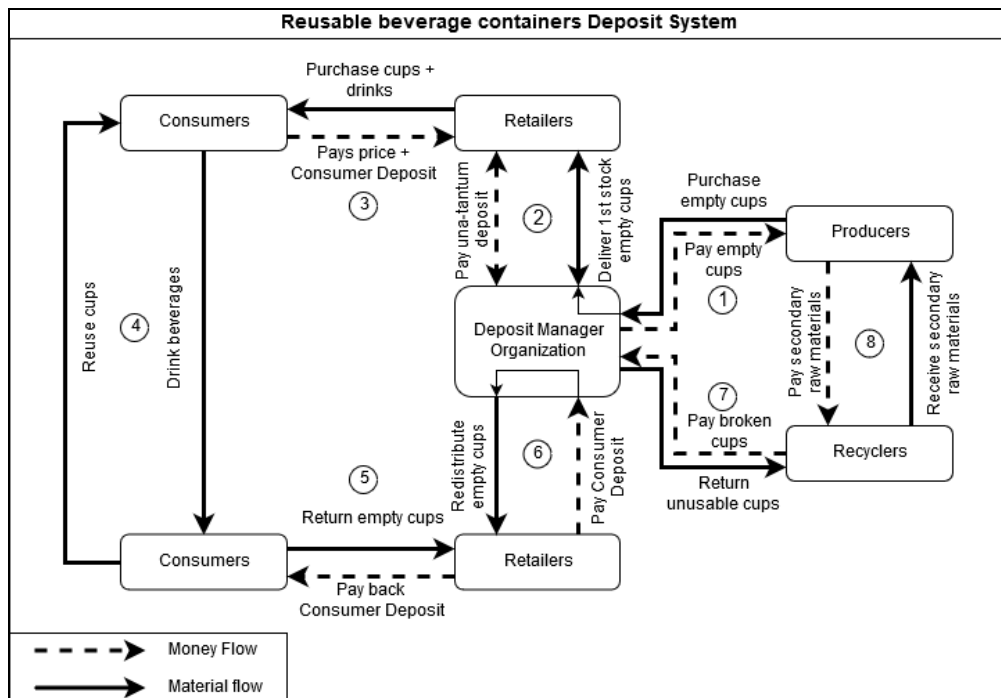


Fig. 3. Representation of a reusable beverage containers Deposit-Return System



The double direction of the arrows, at this stage, means that retailers can stop and give back, at any time, the furnishment of cups. The agreement between the DMO and the Retailers can be one, or many, year long and it guarantees to the Retailers, for all the life of the agreement, to have a constant stock of cups. Third, as in the single-use DRS, Retailers deliver the empty cups to Consumers when they buy a beverage by receiving the Consumer Deposit (3) and consequently, Consumers use, and re-use, the cups as many time as they want (4), stacking the cups in a reuse loop. At any time, Consumers can return the empty cups to the retailers by taking back the Consumers Deposit (5). At this point, the DMO takes part again in the supply chain by receiving back, weekly or monthly, the Consumer Deposits and by redistributing empty cups among the network of involved Retailers (6). This step, is necessary to close the reuse loop of the cups. The redistribution, instead, is necessary for an integrated system, i.e. a network of Retailers with the same cup and to guarantee to the Consumers to be able to return empty cups to anyone of the involved retailers and not only in the first one where they buy the cups. More precisely, the redistribution meaning is to balance the number of cups according to the individual agreement between the DMO and the Retailers; in other words, the DMO has to deliver cups to each retail in order to guarantee constantly the same amount of the 1st stock of the step (2).

Finally, when the cups reach their end-of-life, e.g. broken, threadbare or unusable cups, the DMO has to collect them in order to send all the materials to the Recyclers in order to enter in the classical and existing Packaging Supply Chain (7, 8). This Deposit System, in other words, based on the same logic of the single-use containers Deposit System, increases the life of each cup from few minutes to years by stacking the flow of materials within the steps (3), (4), (5) and (6) and transforming a constant flow of materials made by single-use products into a, temporary (a few years), stock of materials.

#### *4.2. Business Model Canvas*

In this section, the business model canvas is presented, in order to document the business model with a visual tool which describes PFM's value proposition, partners, resources, customers, and finances. The PFM's mission is to offer a simple and effective solution to encourage the adoption of consumption models related to reuse practices, starting with drinks consumed in bars, cafes and clubs. The experimentation phase took part in Turin, Italy, in 2019 and during the implementation phase many new activities and players came up, transforming the initial business idea in something more integrated with the city. Out of what is described in Fig. 4, a couple of considerations can be made:

- in order to maximize the awareness on single use plastic consumption and its impact, partners engagement is crucial; committed partners can involve other new partners and suppliers, enhancing the resiliency of the entire supply chain; moreover, they can involve and engage all the consumers, creating a real community and supporting an indirect education for consumers;
- the integrated system support is the main advantage of PFM. Consumers can turn back or refill their cups in any point of the network (commercial points);
- in order to scale up the business, increasingly involvement by new partners is crucial; the business needs to scale also in different operations, as already experimented, such as public events, concerts and exhibitions.

#### *4.3. Analysis of customer perception*

An online survey has been conducted in the months of June and July 2019 to understand consumers and citizens' drinking habits at night and to explore the perception of users' related to the introduction of reusable cups within the Turin's nightlife. Two hundred

and twenty-eight answers were collected (27 in English from foreigners and 201 in Italian). The survey was composed by three main sections: 1) personal and registry information (profession, age, gender, ..); 2) drinking habits and nightlife routines; and 3) consumers' feelings and perception about reusable cups and Deposit-Return Systems.

4.3.1. Personal information

A percentage of 36.6 of the respondents were male and 63.4% were female, 71% were between 18 and 25 years old, 27.5% were between 25 and 40 and 1.5% between 40 and 60. 77% were students, 20% were employed and the remaining 3% were unemployed. Finally, the majority were resident in Turin (61%) or lived in Turin as students/workers (28%) while the rest (11%) was living outside Turin.

Plastic Free Movida				
<b>KEY PARTNERS</b> - Consumers - Bars, cafes and clubs - Bloggers - Municipalities - Reuse Business Model Expert - Engineering partner - Regulatory Expert - Other institutionals partners	<b>KEY ACTIVITIES</b> - Raising awareness of customers and consumers - Selection, customization and distribution of reusable rigid plastic cups - Personalized glass washing service, collection and re-delivery - Redistribution of new cups and deposits - Integrated management system for the customer relations - Graphics and communication - Organization of promotional events  <b>KEY RESOURCES</b> - Reusable cups - High performance dishwashers - Mobility system and transport for the cups redistribution service - Logistic know-how and integrated systems - Strong staff commitment on environment protection and social innovation issues - Communication skills - Fundraising skills	<b>VALUE PROPOSITION</b> Offer an integrated empty return system for beverages sold, through the use of reusable rigid plastic cups and a customized pay-per-wash service, capable of increase commercial positioning and reduce the waste of single use plastic.	<b>CUSTOMER RELATIONSHIPS</b> - Direct contact with the customer (email / phone / whatsapp / meeting) - Newsletter  <b>CHANNELS</b> - Cups (with customized graphics) - Web site - Social Media (Facebook, Instagram) - Events / concerts / exhibitions	<b>CUSTOMER SEGMENTS</b> - Bar owners - Event organizers - Catering companies - Public entities - Food and Beverage operators - People sensitive to environmental issues, disposable plastic and social innovation - People who want to save money on the purchase of disposable products and waste generation - People who like to share their experiences through social media
<b>COST STRUCTURE</b> - Purchase of reusable cups - Purchase of dishwashers - Purchase of transport vehicles for cups redistribution - Marketing & Communication - HR and salaries - Taxes		<b>REVENUE STREAMS</b> - Revenues from the refill of the cups capital for each client - Revenues from the washing and delivery service - Revenues generated by the licensing of the brand - Sponsorships and donations		

Fig. 4. Business Model Canvas of Plastic Free Movida case study for a Deposit-Return System for reusable cups

4.3.2. Drinking habits and nightlife routines

This section was focused on analyzing the average attendance of users in the nightlife and the average number of drinks per night in order to quantify the possible impact of a Deposit-Return System. Perception on the plastic recycling was also asked, as well as if consumers usually drink their beverages in plastic or glass cups. About the drinking habits there were three questions: 1) “How many times in a month do you drink in the city at night?”, 2) “How many drinks do you consume on average in an evening?” and 3) “How often are you served the drink you asked for in a plastic cup?”.

With respect to the first question, 30% of the participants at the survey drinks more than 4 times per month, 33% between 2 and 4 times per month and 33% declared between once or twice per month. The majority drinks more than one cocktail per night (70% between 1 and 3 cocktails per night and 26% between 3 and 5 and 3% more than 5 cocktails per night).

These first questions, together with the first section questions, ensured that the answers came from usual attenders of the nightlife in Turin. Finally, with respect to the third question “How often are you served the drink you asked for in a plastic cup?”, 60% of the sample declared “quite often”, 29% stated “in occasion of big affluence” and only 11% answered “rarely”.

#### *4.3.3. Consumers’ feelings and perception about reusable cups*

In this last section, the aim was to understand the feeling of the consumers facing with reusable plastic cups and their perception with respect to the service of recycling of single-use plastic cups. There were 6 main questions: 1) “When you finish your drink, what do you usually do with the plastic cup?”, 2) “What do you think will happen to the plastic cup you’ve used?”, 3) “Would you feel uncomfortable consuming a drink in a reusable cup?”, 4) “How much are you willing to pay for a reusable cup if the bartender changes it with a clean one every time you get a new a drink?”, 5) “If the bartender gave you the possibility to choose between a reusable cup and a plastic cup, which one would you pick?” and 6) “If you find a reusable cup on the floor, would you pick it up and bring it back to the bar?”.

The first two questions aimed at understanding the perception related to the recycling of plastics. Surprisingly, the majority doesn’t care about throwing correctly the single-use cups. Indeed, the 48% declared to throw it into a generic bin (not the plastic dedicated bin), 10% declared to leave it in the street, 10% to bring back it to the bar/pub while only the 26% declared to deliver the plastic cup into a plastic bin. This behaviour is further confirmed by the scarce trust into the recycling service. In fact, the second question revealed that 70% believed that plastic cups end into a landfill or directly disperse into the environment (12.7%). Only the 17.3% trusts the recycling service. Finally, the last four questions analyzed the users’ feeling with reusable plastic cups. Only 4% declared to feel uncomfortable to drink into a reusable cup due to hygiene, while 48% stated both to be adverse if the cups are not properly washed and to not have any problem with reusable cups usage.

With respect to the average price for the deposit, 36% wish to pay less than one euro, 59% between 1 and 2 euros and 5% more than 2 euros. With respect to the fifth question, the majority prefers a reusable cup (93%) against a single-use cup (7%). Finally, the last question analyzed the users’ behaviour on picking up empty cups within the street, confirming that the introduction of a Deposit-Return System may solve the littering problem thanks to the deposit. Indeed, 70% declared to collect an abandoned cup, 24% maybe and only the 6% not, I wouldn’t.

## **5. Concluding remarks**

In this paper, a Product Service System for a Deposit-Return System for reusable cups has been introduced. The pilot project here described, run in the city of Turin in the month of July and August 2019 and still active, allowed to transform a flow of material into a temporary stock of material. The case study has been validated by a survey related to the behavior and the perception of usual nightlife attenders. The results from the survey revealed that night attenders have a scarce trust on the local recycling multi-utility company of the city of Turin. Moreover, answers from the survey pointed out that the majority of nightlife attenders in the city of Turin don’t care about correctly dispose single-use plastic cups.

The latter feature can be easily solved by introducing a Deposit-Return System for both, single-use and reusable cups, as highlighted from the survey. 70% declared that with a DRS would collect abandoned cups in the street and 24% maybe. Thus, the described Business Model and the related Material Money Flow shows how introducing a new actor into the classical DRS for single-use cups it is possible to create an integrated network of retailers at urban level and to boost reuse practice within a city for a targeted product (in this case, plastic cups).

Even if, survey's results and preliminary outcome from the pilot project are satisfactory several aspects have to be further investigated. First, a Life-Cycle Assessment must be done in order to compare classical single-use container DRS with the proposed DRS for reusable cups and to identify possible inefficiency, from an environmental point of view, and to reveal the "environmental break-even point". Indeed, the production of reusable cups need undoubtedly more energy and raw materials (the weight ratio between a single-use and a reusable cup is about 1:10), as well as the repeated washing of the reusable cups squanders a large amount of water. Second, current plastic cups producers are selling products, i.e. reusable cups, only tested, in a large scale, during temporary, from a few days up to a few weeks large festival.

Thus, the effective durability of a reusable cup is still to be assessed within the daily life of a bars. It is clear that within bars, restaurant and clubs of a city the usage is much more intensive with respect to a time-limited event. Finally, eventually administrative barriers in different countries have to be analyzed. Existing national, regional or local regulations could stall the scale up of such a model due to hygiene, public safety in the street or to simpler lack of appropriate laws for DRS. On the contrary, a DRS for reusable cups, if implemented at urban scale, could allow to collect information related to social practices, such as social drinking. Merely by developing a smart cups, e.g. a monitoring system which can track drinking habits of citizens and the flow of the cups within the city, it may be possible to collect current unavailable data on several social phenomena related to the nightlife.

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### **Conflict of interest**

The principal investigator Dario Cottafava is one of the cofounder of the promoting NGO involved in the case study described.

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