Towards Greater Sustainable Logistic Packaging for FMCGs:

Mission Impossible?

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1 Introduction

The aim of this study is to explore if and how, in France, logistic packaging[1] for Fast Moving Consumer Goods[2] (FMCG) could be (more) sustainable (than it is today).

The question of increased sustainability has become key nowadays considering that global conditions are evolving rapidly and sometimes drastically. Legislative and regulatory framework are becoming more and more stringent, driven by strong political willingness and circular economy principles applied into European and national laws, raw material & commodities shortages and price volatility are influenced by oil price and geopolitical tensions, fiscal burden is becoming heavier in order to incentivize gradual shift towards greener economy and business opportunities dry up. Recent China ban on waste import illustrates, if need be, the rapidity and importance of unexpected external factors heavily impacting a whole industry (i.e. recycled material supply).

Among the top 30 FMCG companies worldwide[3][4], two are of French origin (L'Oréal and Danone), eight are from other European countries and many companies amongst the top 30s have a strong French industrial footprint. France is also well represented in the worldwide top 30s distribution sector including retailers like Carrefour, Auchan, Casino, Leclerc.
Since the regulatory and taxation landscape as well as retail practices and waste management services are rather different from one European country to another, this study focusses on France in order to be relevant regarding analysis and recommendations. However, approach and methodology could be applied to assess any other country, by varying the various components of the equation, including aspects such as waste collection, recycling capabilities and infrastructures and amounts of contributions and taxes levied.

Logistic packaging is used to aggregate consumer product selling units into a convenient unit load for supply chain efficiency. It is generally disposed after use. The consumer goods industry and mass retail complex supply chain schemes generally comprise several steps between production sites and stores. They generate a significant amount of break of loads and re-packing operations resulting into packaging waste, which is not always recovered for recycling, depending on waste management programs in place. Logistic packaging is mainly composed of wood, corrugated and plastics, using both virgin and recycled materials but not always from sustainable source.
FMCG is an important producer of Green House Gas (GHG) emissions in the entire goods life cycle[5] (estimated to 60% of worldwide emissions - (Berruti, Giorgi, & Morgan, 2017). According to Thierry Gaillard, Ania[6] VP in charge of sustainability "the Food & Beverage industry contributes up to a third of the global CO^2 emissions from raw material production up to final consumption". At the same time, due to its large consumer exposition, the Food & Beverage and retail industries have developed a strong

[1] Also referred to as secondary and tertiary packaging or transit packaging
[2] food and non-food non-durable products with low nominal value and high repurchase frequency
[3] See appendix 8.2
[4] See appendix 8.2
[5] Life cycle (or cradle to grave) = environmental impacts of a product all along its useful life: from its raw material production to its end-of-life disposal, passing through production, transportation distribution and consumption steps.
[6] Ania = Association Nationale des Industries Alimentaires

concern, specific policies and efficient communication with regards to sustainability practices and processes.

A restrictive definition if sustainability[7] applicable to logistical packaging can be retained:
"Sustainability is the cleanest way to procure, produce, deliver and ensure disposability of one's product" (PwC).

For the sake of clarity, this study will focus on environmental aspects. Governance, Social & Human Rights aspects of Social Responsibility (such as Labor Practices, Business Practices …) will not be covered by this thesis due to its scope.

Many stakeholders, including NGOs and NPOs, are influencing this stronger focus by playing a role of gatekeeper and whistleblower when countries and industries are drifting from the agreed 2°C trajectory. Not only they alert, but they also can play an active role in closing the gap of GHG emissions (Berruti, Giorgi, & Morgan, 2017).
Professional associations and waste management companies actively contribute to spreading best practices and prescribing solution from eco-design to end-of-life management.
Ultimately, end-consumers, being more and more aware of sustainability, play an increasing role in driving change, using their communication powers through social networks (name & shame).
Hence, given the political, ethical, sociological, ecological and economic contexts simultaneously converging on sustainability to overcome the challenge of keeping a clean and viable world for future generations, this study envisions to set a status on the state of the art situation and identify existing or potential solutions contributing to reducing the GHG footprint of logistic packaging. It is done within the framework of a packaging distributor and therefore contributes to enhancing the value proposition for green(er) solutions.
In order to cover sustainability in logistic packaging, a thorough analysis of context, status quo, major drivers and trends will be made, relying on both secondary and primary sources.
Packed product characteristics (perishable or not, controlled temperature, …), distribution channels (with emergence of on-line business as an alternative to mass retail chains), packaging material characteristics regarding sourcing and recyclability as well as waste management (collection and recovery) and recycling facilities will be analyzed to identify improvement areas for an enhanced compliance to sustainability and a positive contribution to the environmental targets.
Based on primary and secondary data and information collected and analyzed, findings, guidelines, recommendations, identified best practices as well as existing and potential solutions will be made in order to provide to the FMCG industry and distribution (retail, e-commerce and omni-channel[8]) with a more sustainable approach towards logistic packaging.

[7] The initial definition of Sustainability – remaining still the reference – has been given by the (Brundtland, 1987): *"Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs".* Sustainability is consequently threefold: economic, social and environmental (A.Remmen, Jensen, & J.Frydendal, 2007). It encompasses all the activities of a company and has been transposed into organizations as CSR (Corporate Social Responsibility).

[8] Omni-channel: all distribution channels – off and on-line- offer the same experience and can be served with one product; in this case, logistic packaging.

2 The Context of Packaging

2.1 Types of Packaging

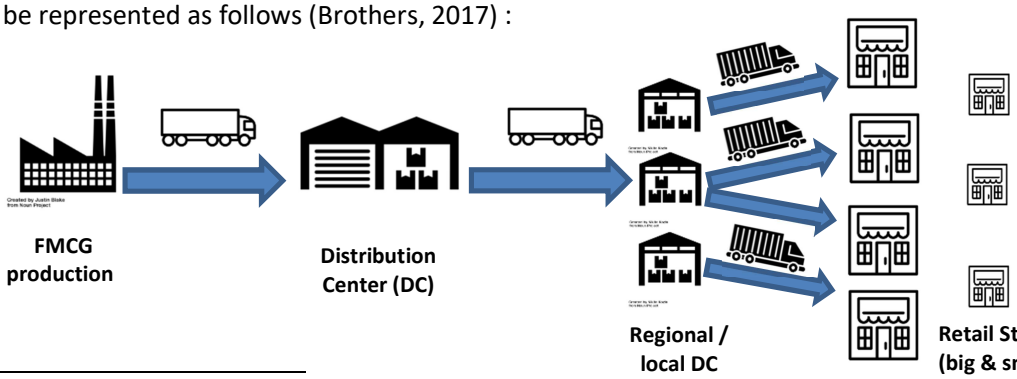
2.1.1 FMCG

FMCG stand for "Fast Moving Consumer Goods". They are composed of food and non-food non-durable products (product useful life below 1 year) with fairly low nominal value and high re-purchase frequency[9] (Brothers, 2017). FMCG rely on retail distribution in order to market their products. Their respective supply chains are complementary and inter-dependent bringing products from production sites to point of sales. Therefore, an analysis of FMCG cannot be conducted without looking at the downstream aspects of distribution. Although FCMG are (still) fast growing in emerging markets, they are facing challenging trends in Western economies, alternating good and bad years[10]. This is exacerbating the highly competitive spirit not only within the FMCG companies but also for retail chains. This is materialized in annual negotiations where brands can see erosion of volumes and/or profitability. This context leads to a strong tropism for cost optimization on both sides. These industries use standardized and proven processes for production factories and supply chain worldwide. Consequently, because FMCG are global, sustainable solutions developed in one place can be adapted and transposed all over the world. especially into areas where sustainability has become key for ecological survival. Additionally they can be implemented more easily because taken into consideration from conception phase (eco-design not only for product and packaging but also for infrastructures) as they constantly re-organize their footprint and invest into new facilities. For all the above mentioned reasons, FMCG industry and associated retail distribution networks are an interesting and relevant field of study. This study will not differentiate food and non-food products as most HACCP[11] points for food product safety are generally covered with primary packaging.

Packaging is answering the need to protect selling unit / products and then move this selling unit from production site ultimately to point of sales.

The traditional FMCG supply chain is split into FMCG manufacturer (brand owner or not) and the retail distributor. It also often involves third-party logistic companies.

It can be represented as follows (Brothers, 2017) :



[9] Because this study focuses on France, pharmaceutical and tobacco industry will remain out of scope as they follow a specific and controlled supply chain.

[10] http://www.nielsen.com/fr/fr/insights/news/2018/grande-consommation-en-france---un-bilan-2017-encourageant.html

[11] HACCP = Hazard Analysis Critical Control Point: methodology for food safety risk identification.

As it can be seen from the flowchart above, the challenge of sustainability needs to be tackled at different levels, with different actors and in various ways:

Firstly, transportation is everywhere at around five times on average from production to store (Fischer & Lilienfeld, 2017) and cannot be always avoided. When storage and transportation are involved (except from store to home), so is logistic packaging.

(Fischer & Lilienfeld, 2017), (Brothers, 2017) and (Hugrel & Palluau, 2014) classifies packaging in two main categories:

1- Retail packaging (or primary) corresponds to a "selling unit" in point of sales: packaging is containing and protecting the product, supporting all marketing allegations, communicating brand image and giving information such as product composition, instructions for use or legal disclaimers and barcode. This primary packaging ultimately enters consumer's home.
2- Logistic packaging (or secondary/tertiary) is the disposable packaging, in most cases remaining hidden from (and unknown to) the end-consumer. It is used, for FMCG, to group products together for optimizing supply chain operations. This packaging can be removed from retail selling units without changing product characteristics[12]. Two levels of groupings can be distinguished:
    a- First level = secondary: retail selling units are grouped into a more standard unit load (generally corrugated case) defined by its shape (stackable), size and weight (ease of storage and manual handling in retail stores) which is a key driver for retail chain to ensure labor time and costs optimization when restocking store shelves. This box is generally disposed when products are shelved. However, specific boxes, called shelf-ready packaging [SRP][13], are a multi-purpose packaging serving both logistic and retail. They are directly put on the shelves in order to save process time and speed-up the shelf re-filling process. Specific products, such as fresh and perishable food, could also be directly put into re-usable and sometimes foldable plastic or expanded polystyrene (EPS) containers (Conseil National de l'Emballage, 2017) & (Efficient Consumer Response Europe (ECR), 2007).
    b- Second level = tertiary: secondary packaging boxes are in turn grouped into a larger volume. They are generally piled up on a standardized pallet and either strapped or filmed – or both. Main target of wrapping packaging is to ensure pallet stability, thus avoiding people injury or product damage in case of a pallet collapse during transport and/or storage[14].These unit loads can move securely and conveniently through the entire supply chain, from production plants to logistic platforms, to retail stores stocks and, ultimately, up to the supermarket aisle until products are shelved.

[12] However, logistic packaging does not include containers devoted to sea, air, rail or road transportation.
[13] SRP = Shelf Ready Packaging includes on-shelf trays, pallet boxes and re-sable plastic trays for ready-to-sell and display ready
[14] Load stability is governed by norm EUMOS 40509, ; http://eumos.eu/quality-standards/

An illustration of a packed consumer product pallet is shown in image below:

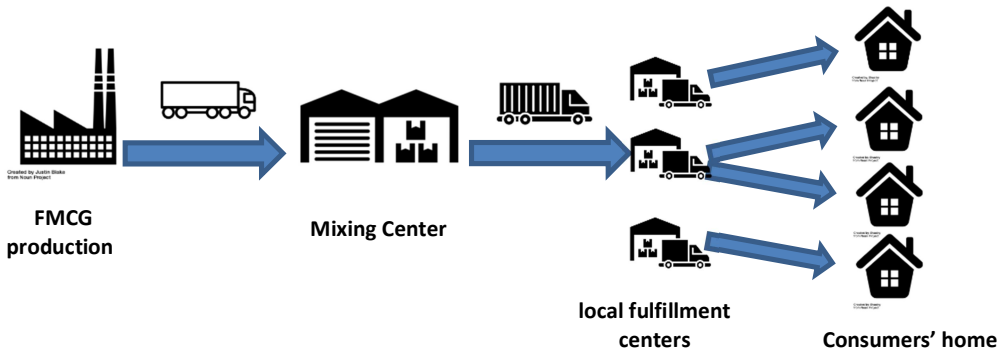
2.1.2 On-line

Alongside the more traditional “brick and mortar”, emergence and fast-growth of e-commerce is altering the well-established model, following a significantly different pattern, from purchasing and through supply chain.

Hence, logistic packaging plays a slightly different role: it is of course fulfilling its primary objective to protect a product (single or few heterogeneous products grouped together in one container: box, bag, other …) during transportation until point of delivery – generally consumer’s home-, but it is also contributing to a unique (or not) consumer experience (Fischer & Lilienfeld, 2017): only in e-commerce logistic packaging is the first element to touchpoint with the consumer.

Generally, e-commerce packaging is about 1 parcel for 1 product; but it can well be a basket of several/numerous heterogeneous products (grocery shopping) to fit into one or more box (Ballot, 2016).

Whatever the channel, products depart from the same production site. But when sold through on-line channel, they experience a significantly different supply-chain flow until it gets in the consumer’s hands (Rashbrook, 2017) & (Fischer & Lilienfeld, 2017).



Traditional retail and e-commerce are already and will increasingly converge[15] as buyer behavior is changing. More convenience (home delivery) and more omni-channel experience are required as buyers purchase the same consumer goods through on- or off-line channel, depending on which channel is available and more suitable at the time of purchase (Rashbrook, 2017).

This study will focus on FMCG through existing traditional retail. However, given the aforementioned evolution, some parallels will be made with e-commerce for a potential more global approach and convergence of logistic packaging for a global sustainable solution.

2.2 Materials used for Packaging

Overall, materials used for logistical packaging belong to 3 main families:

- Wood for mostly pallets
- Paper and board (corrugated and Kraft paper) for boxes, interlayers and corner protection
- Plastics (HDPE, LDPE, PP and PET) for stretch or shrink films, strapping, corner protection and re-sable pallets and boxes

Each material is more or less devoted to a type of logistic packaging.

2.2.1 Pallets

Pallet has become the standard for logistics in the 1970's when growth of consumption and development of mass retail increased the need for transportation between production sites and purchasing locations. Over almost 50 years, manufacturers[16] efficiently optimized production, use, repair, reuse and disposal of pallets (Roussel & Svilar, 2015).

Pallet can be made of wood, metal, plastic and now corrugated (Pearson Specter, 2018) and is exiting in various sizes. For FMCG, 2 sizes represent the bulk of the volume: the standard 1200x800 Euro pallet and 600x400 half-pallet. These sizes allow optimum loading plan for semi-trailers with 33 Euro pallets.

In France, wooden pallet (new & refurbished) represent 95% of the market (Roussel & Svilar, 2015) – the reminder being split between metal and plastic, corrugated being still anecdotal.

Pallet industry is centered on 3 major actors: pallet manufacturers, pallet rental companies and pallet refurbishment companies. All of them are contributing to making this industry efficiently organized.

In terms of sourcing, pallet industry relies on mainly two options, both being sustainable. It can be either wood coming from sustainably managed forest (FSC / PEFC)[17] or it can be wood coming from tree-

[15] Amazon and Whole Foods, retailers on-line: Auchandirect, decathlon.fr, FNAC.com …

[16] Although associated to Packaging, pallet is a bit hybrid because pallet manufacturers are not into packaging industry but limber industry.

[17] FSC was created in 1994 following the Rio Earth Summit of 1992; its role is to ensure, through certification, that limber actors manage properly and sustainably the wood resource. It is a highly recognized label.

thinning (that would have been either discarded or used as wood fuel). Although sustainable, wood resource could be considered finite as regeneration can be longer than consumption time. This gap can partially be closed by extending the lifetime of a wooden packaging. The slow growth of timber compared to increased usage created an un-balanced demand/offer resulting into price increase in Q4 2017[18].

Regarding end of life, decommissioned pallets are grinded into wood chips used for industrial heating (80%) and for construction (20% with wooden walls and timber frames & structures) as well as composting for agriculture. This resource is substituting construction materials or fossil energy, big providers of waste and CO^2 emissions[19]. So wood never constitutes a final waste since even its end of life benefits to economic agents.

Wood is also considered as a CO^2 stock. This characteristic allows granting pallet a negative CO^2 emissions balance (Roussel & Svilar, 2015).

2.2.2 Boxes

Boxes are mostly made of corrugated board for a single use and dispose. They can also be made of plastics allowing re-use. Boxes are the most used secondary packaging. They allow grouping of Selling Units into an easily manually handled unit for in-store manipulation: the Logistic Unit (Conseil National de l'Emballage, 2017). The corrugated can sometimes be printed with either brand image or logistic instructions to ease the product recognition and order preparations in warehouses (Conseil National de l'Emballage, 2017).

In traditional retail, pallets of open or closed boxes of products are brought into the store aisle, products are manually shelved and corrugated box is flattened and collected for evacuation. In case of a Shelf Ready Packaging [SRP], the same process occurs but when empty boxes are removed from shelf and replaced by full ones.

When it comes to e-commerce, this box is both a logistic item and a consumer over-packaging. It then contains cushioning and/or void-filling materials [20] in order to ensure product protection from damage during all the steps of logistic chain, from fulfillment that can be manual or mechanical until the “last mile” which can be critical in terms of parcel exposure to shocks and compression[21].

Corrugated is in its vast majority a single-use product already achieving a high recycling rate (96% in 2013 (Haeusler & Berthoin, 2016)). If 100% recycling can be achieved , 100% recycled corrugated is an illusion as it need to mix virgin fibers (25%) with recycled pulp (75%) to ensure required mechanic properties of corrugated (Confederation of Paper Industries, 2017). Virgin fiber is generally sourced from a certified

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PEFC was created in France in 1999 and became a worldwide organization in 2001. It is the world leader of sustainable forestry certification.

[18] http://www.epal-france.fr/2018/02/19/hausse-prix-bois/

[19] http://www.sita.fr/bois-et-palettes/

[20] Cushioning / Void-filling are packaging materials used to protect a boxed product to mitigate break risks resulting from impact

[21] https://www.60millions-mag.com/2016/11/29/livraison-domicile-pourquoi-tant-de-problemes-10811

origin like PEFC and FSC[22] which grants a sustainability guaranty. Corrugated, especially brown, benefits from a good sustainable image in the consumer's view.

2.2.3 Films and Strapping

Films and strapping bands are used to secure the load on the pallet. This aspect is fundamental to ensure cargo stability and safety during transportation and storage[23]. They can be used separately on jointly. Films, both stretch and shrink, are made of LDPE (or LLDPE), a fully recyclable material[24]. They can be transparent, white or colored. Strapping is a thin band of PP or PET, used to secure loads on a pallet. It is also used for e-commerce boxes as an anti-theft protection mainly preventing any unauthorized box opening.

Plastics are suffering from a strong negative image. This is reinforced with all reports on plastic pollution, especially in the marine environment. Many countries, as France, have banned or restricted usage of plastics packaging for their lack of biodegradability. It is commonly agreed that 400 to 450 years are necessary for plastic films to fully degrade in natural conditions. Plastic directly littered in nature (including landfill) is causing immense damages to the nature and wildlife. NGOs are using media hype around these dramatic events to alert and sensitize population[25] and drive behavior change.

It should not hide the fact that plastic has some sustainable aspects: it does not require lot of energy for manufacturing and, thanks to its light weight, actively contributes to reducing load transported and associated GHG emissions linked to freight. Films are now considered more as a commodity than as a technical product. It is nevertheless highly technical. Thickness down-gauging not exceeding few microns while maintaining mechanical specifications through several layers of PE, sometimes bi-oriented for higher resistance is achieved at industrial scale.

From an economic standpoint, plastic is rather unexpansive due to raw material and production costs. Indexation to oil price is impacting PE and PP indexes such as ICIS, resulting in increased price volatility.

2.2.4 Ancillaries (interlayers, corner protection, labels …)

Ancillary packaging materials comprise all additional elements not directly containing cargo but necessary for the overall cargo stability and protection and for logistic information.

Interlayers main purpose is to avoid cargo movement thanks to anti-slip characteristics. They can be made of plain board or corrugated PE. They are necessary mainly for non-boxed products (e.g. bottles) in order to increase stability due to little overlapping surface.

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[22] See note 17
[23] See note 14
[24] See appendix 8.6
[25] https://www.wwf.fr/vous-informer/effet-panda/bruxelles-contre-plastique
https://www.google.de/search?rlz=1C1GGRV_enFR783FR783&ei=Js4YW9_qMcz7UNHRmYgN&q=baleine+morte+plastique&oq=baleine+morte+plas&gs_l=psy-ab.1.0.0j0i22i30k1.2070.2524.0.4082.4.4.0.0.0.0.184.463.0j3.3.0....0...1c.1.64.psy-ab..1.3.461...0i22i10i30k1.0.0KD7DN5AsDs

Corner protection helps avoiding goods damages resulting from tight strapping. They are generally made of cardboard but can be made of PP plastics.

Adhesive tapes are used to close boxes. They are made of PP or PVC. They are mostly not recyclable because of glue, solvent and silicone added to provide adhesive characteristic. They also contribute to recycling feedstock quality downgrade as introducing externalities into recyclable material (corrugated).

Self-adhesive labels are also very important as they carry all relevant information to ensure traceability throughout the supply chain. They can be made of adhesive paper or PE plastics. They are printed on demand and added (glued) directly on the pallet wrapping. Although not costly, label is a highly sensitive article as it ensures supply chain efficiency. It gives the right information (selling unit, logistic unit, barcode and global location number (GLN), delivery place …) - generally written and bar-coded – to be recognized by optical readers as well as by warehousemen.

Document pouches are an alternative to self-adhesive printed labels; they are stuck on film or box and contain a label printed on paper and inserted into the pouch.

2.2.5 Comparative Table: retail vs on-line distribution channel

Supply chain has a strong influence on logistic packaging. Depending on product weight and volume, distance to be covered, break of loads and many other factors guiding choice of logistic packaging can be manifold.

Retail	e-commerce
	Protective in-the-box packaging (cushioning and void-filing – all types)[26]
Corrugated boxes (closed or open)	Corrugated boxes (closed)
Pallets / interlayers / corner protection / strapping bands / tape	Strapping bands / Tape
Films (stretch & shrink)	Shrink films / bubble wrap
Labels / document pouches	Labels / document pouches

An important overlap exists on these two categories in terms of product groups but details can differ.

However, some research suggests that FMCG packaging current formats might not fully fit the specific needs of e-commerce (especially the last mile) and new solutions have to be developed (Fischer & Lilienfeld, 2017).

Nevertheless, lessons learnt from one side can provide the other side with valuable inputs, especially with increasing on line shopping (grocery or other but especially grocery as implying heterogeneous products – comparable to small store delivery).

[26] See note 20

2.3 Market and Key actors

FMCG logistic packaging market is not easy to define. Many sources have been necessary in order to approach a value. It can be estimated for 2016 at EUR 25.2 billion worldwide and EUR 1.1 billion just for France and growing to EUR 1.5 billion by 2022[27].

Key actors of this market are numerous and their interactions can be multiple.

First[28], Packaging manufacturers either produce according to, market standards or their own specification or even make packaging according to particular customer specifications (and this could also go through converters for the made-to-measure part). Packaging manufacturers are addressing their market directly when certain conditions of volumes and order frequency are met. They also address smaller volumes or specific needs through B-to-B packaging distribution and converting.

Then, Industrial FMCG companies are chronologically the first and the biggest consumer of secondary and tertiary packaging. At the end of production lines, pallets are built-up by stacking secondary packaging and then strapped and/or filmed. Packaging products must fit high-speed fully-automated production lines. The primary target is to meet quality and regularity standards to ensure flawless production process.

Next, 3PL are specialized logistic companies ensuring on behalf of their ordering customers (FMCG or distributors) the transportation of the goods from production site to stores, going through a certain number of distribution centers.

After that, Retail distributors market the FMCG products in their stores. Store size can range from few hundred square meters to above 20.000m² for the largest. They are using logistic packaging to prepare store replenishment orders organized by pallets or roll-cage trolleys.

Finally, Waste collection companies and recyclers are closing the loop. Their mission is to remove the waste (including packaging waste) from all locations (industry, logistics and distribution). Waste is sorted and either recovered in energy production or recycling; if not recoverable, it can go in landfill. Recyclers procure the recycling raw materials from waste management companies. Often, waste management companies have developed their own recycling capabilities.

2.4 Other stakeholders (NGOs, NPOs, Customers, shareholders…)

Many NGOs and NPOs[29] are active in the field of sustainability. Some of them are historical, such as Greenpeace or WWF and have acquired their respectability over the years of action for better environment. Some of them are more recent, such as CDP (formerly Carbon Disclosure Project) or Global Reporting Initiative (GRI) and have gained trust through their serious work based on independent

[27] See appendix 8.1
[28] Raw material suppliers for pallets (wood), corrugated (pulp) and plastic packaging (plastic polymers) are not covered in study.
[29] See appendix 8.4

assessment of compliance to UN Global Compact and following policies. They have set standards now internationally recognized and used by major industries, among which FMCG companies.
They actively work into defining and supporting implementation within Energy and FMCG sectors of strategies and actions aiming at emission reduction. Other type of NGOs, although not dedicated to sustainability, are playing an increasing role: for example World Economic Forum or Consumer Goods Forum and many others contribute with a more business and economic view on this topic that they now consider as key for the future: sustainability.

Professional associations aiming at monitoring regulatory and technical landscape evolution, analyzing trends and developing operational excellence within their sectors enter as well in the influencers' category. They issue more and more white papers on sustainability and can actively contribute to spreading best practice within their industry.

Shareholders & investors are as well increasingly looking and influencing CSR policies of companies. Global warming resulting from GHG emissions creates adverse weather risks potentially affecting assets and business and -2°C trajectory of companies induces low-carbon transition risks. Both risks can affect company's performance over time, thus valuation (Hubert, Nicol, & Cochran, 2017). This is also encouraged – or incentivized – by the article 173-VI aiming at aligning investment portfolio and de-carbonation trajectory (Forum pour l'Investissement Responsable (FIR), 2016) or by the UNEP Principles for Responsible Investment (2006). Recently, NGOs publically asked Black Rock's[30] CEO Larry Fink to walk the talk and influence sustainable behavior of companies of Black Rock portfolio and exit carbon-intensive activities (Rolland, 2018).

Ultimately, individuals, be it customers or employees, are also playing a growing role. They claim for more sustainability from their employers and/or from their preferred brands. But by requesting better products at cheaper price, they force companies to look for most cost efficient solution. And when facing a bad packaging experience (both excess primary and secondary for e-commerce), some consumers are prompt in "naming & shaming" and sharing this with full details and pictures on social networks (Rashbrook, 2017). Employees also request more and more a sustainable behavior from their employers. They can quit a position if policy is not in adequacy with their beliefs. FMCG companies and distributors, generally building their brand image through customer proximity, want to stay away from this type of bad publicity that could affect brand reputation and customer loyalty.

All these direct or indirect, minor or major "influencers" play a more or less important role in the transition to more sustainability. The variety and quantity of these influencers make it difficult for Consumer Goods and Retail companies to avoid tackling sustainability.

2.5 Relevant Packaging Legislation and Standards

Sustainability is, in many countries, governed by laws, directives which are, to a certain extent, transcription in national frame of upper level directives set-up by supra-governmental bodies such as EU

[30] Black Rock is the biggest Asset Management company with USD 6288 trillion assets under management

or UN and this since quite a long time. The European directive 94/62/EC on "Packaging and Packaging Waste" issued on December 20, 1994 is the cornerstone of packaging sustainability approach. It has been updated several times, especially with decision 2005/270/CE whose targets are:

- Generalization of EPR (Enlarged Producer Responsibility)[31]
- Priority given to packaging waste prevention and recycling through precise guidelines in regards to packaging optimization, material content (hazardous materials) and end-of-life management.

In France, the various European directives have been adapted and integrated over time into "Code de l'Environnement". This legal framework establishes a clear distinction between EPR for household waste and non EPR for retail and industrial waste.
Retail and Industrial Packaging waste is governed by articles R.543-66 to R.543-74 of "Code de l'Environnement" stating that packaging holders shall make their best efforts to sort and recover as much packaging waste as possible, themselves or through authorized professionals.

Legislative corpus is abundant and encourages transition to greener economy. However, it is complex and ranked #3 in the top 6 main constraints towards more sustainability (Roland Berger Strategy Consultants, 2010).

There are other laws and regulations indirectly influencing logistic packaging, influencing its size and shape: Norm EUMOS 40509 on load stability or labor law articles R.4541-5 & 6 relating to occupational disease and injury prevention resulting from manually handled weight (Conseil National de l'Emballage, 2017).

Laws and regulations are also complemented by standardized norms and best-practice rules.

This legislation and regulatory framework can be considered as Porter's 6th force on this industry[32].

[31] EPR, according to OECD, defines that producers are bearing the responsibility of post consuming end-of-life treatment and disposal of products they put on the market. (http://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm)
[32] Detailed overview of regulatory landscape incl. detailed articles relating to Industrial and Retail packaging waste are available in appendix 8.4 OECD, defines that producers are bearing the responsibility of post consuming end-of-life treatment and disposal of products they put on the market. (http://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm)
[32] Detailed overview of

3 Packaging and Sustainability

3.1 The business case for sustainable packaging

Logistic packaging too often remains an example of a linear economy approach in a world progressively converting to circular economy[33]. In many cases it is still, with single use products, the illustration of the tryptic – take-make-dispose - symbol of the linear model, despite an increasing waste volume oriented towards recovery and recycling. It is now commonly accepted that the consumption model lives on credit. Fossil or non-fast enough renewable resource compared to pace of consumption growth leads to resource scarcity, price volatility and supply shortage which can be harmful for business and companies (World Economic Forum, 2014).

A favorable context towards more sustainability started with creation of UNEP (United Nations Environmental Program) in the early 1970's. It was followed by Global Compact initiative started in 2000 which aims at converting businesses to a more sustainable and socially responsible approach. This is materialized by emergence of Corporate Social Responsibility. It grew stronger after the COP21 in Paris[34] which enacted a worldwide success of political and governmental commitment to climate change. The unpopular withdrawal of the USA combined to climatic disasters even reinforced the phenomenon. Many large FMCG & retail corporations, already engaged into CSR, seized this opportunity to boost their sustainability policy towards more climate-related and environmental actions (Bertrand, Hershey, & Miia, 2016). They did so not only for environmental reasons but also because they expect future growth based on these policies (Rao, 2013). Announced increase in CO^2 tax with a 233% increase in the next 12 years (from 30€ in 2017 to 100€ in 2030[35]) should also encourage change of behavior in regards to fossil-based raw material sourcing, transport and material recovery. Specially, FMCG & retailers have a common challenge to make mass consumption more acceptable from a sustainability stand point. As they are very exposed to consumer scrutiny, they need to collaborate in order to select best sourcing options and reduce waste generation along the value chain. This is not always easy but absolutely necessary to scale-up circular economy to global level (World Economic Forum, 2014).

Logistic packaging impact on logistic efficiency (including transport efficiency) can fully support GHG emissions reduction actions pursued by consumer goods economic players.

3.2 Current practices

[33] Circular economy is often referred to as "cradle to cradle" meaning that waste becomes raw material for new products/applications while linear economy is referred to as "cradle to grave" with post-use disposal when products become final waste.

[34] COP 21: held in Paris in Nov-Dec2015 under the high patronage of the UN; where 176 over the 197 present countries (89.3% - https://unfccc.int/process/the-paris-agreement/status-of-ratification) adopted resolution to contain global warming between 1.5 and 2°C until 2100. This is directly targeting reduction of CO^2 emissions responsible for global warming

[35] See appendix 8.9

3.2.1 Sourcing

Generally, footprint of pallets and corrugated packaging suppliers is local. These articles are produced in the area of consumption because transport cost is rather sensitive with high volumes / light weight and product quality could be affected by climatic condition change (hygrometry) (Conseil National de l'Emballage, 2014).

However, these rules do not apply to plastic packaging products. Suppliers are more spread as transport is less critical for these types of products. Hence, stretch and shrink films as well as tape can be produced locally or can be imported from overseas (Brazil, Malaysia, China or the Persian Gulf). Therefore, it is likely that GHG emissions are not considered in the global equation of such sourcing.

3.2.2 Use

Still in numerous cases, homogeneous pallets out of production are broken down in distribution centers with unpacking, order preparation and repacking process. Heterogeneous mixed products on pallets are then proceeding to the next supply chain step until store. Almost each of these steps is generating one way disposable packaging usage and waste (mostly films, strapping and labels). As displayed in § 2.1.1 and § 2.1.2, different supply chain schemes have emerged over time (Brothers, 2017). For store delivery, several devices and logistic flows are used. Consumer goods typology, retail store size and delivery frequency imply usage of different packaging options. Pallets (wooden or plastics) or roll-cage trolleys are filled with very heterogeneous products and delivered, sometimes on the street/sidewalk (see picture 6, p.64). However, some efficient packaging and supply chain have been developed for some heavy or voluminous products like liquids/beverages. They are delivered directly in full or half pallets inside stores: direct store delivery (DSD) (Badouix, 2018). Another often used scheme is cross-docking (Trohay & Lucot, 2018). Full pallets of products are delivered on a mixing platform where they are consolidated with other pallets of other products in order to send one truck to one (or more) store(s). These two schemes allow saving breaks of load, product manipulations – unpacking and repacking operations - and sometimes freight.

Although it does not constitute a genuine target, sustainability is incidentally reached thanks to packaging reduction and optimization – with economic rather than environmental motivation. Key driver is efficiency to keep direct labor as low as possible all along the value chain. From production to waste management (especially in labor intensive retail) maintain low manpower involvement reduces costs and risk of damaged products (Badouix, 2018).

In the supply chain, the most unsustainable element is not logistic packaging as it is mostly composed of fully recyclable materials. Freight, together with storage (especially temperature controlled), are one of the main GHG emission factor for FMCG and Retail (Berruti, Giorgi, & Morgan, 2017)[36]. These emissions are measured as transport is fully incorporated into consumer goods LCA as these emissions are included

[36] For example, refrigerant accounts for respectively 42% in food manufacturers and 30% in retail while truck fleet accounts for 56% of total CO^2 emissions.

in scope 1 and 2 of manufacturers and retailers[37]. This is why professionals actively work on energy efficiency and CO^2 reduction plans.

Urban logistics are becoming a more and more challenging topic (Braouzec, Bros, Genestier, & Samson, 2018). This is affecting both retail and e-commerce deliveries with traffic congestion and sometimes restrictions. As an example, for internet deliveries, 21% of parcels are not delivered in the first delivery loop[38], causing more trucks on the road, more traffic congestion and negatively impacting the CO^2 equation. The major area of improvement in this field is load optimization. If fulfilment of 100% load capacity is not realistic, there is room for improvement as many trucks on the road are running in average at filling rate of 50% or lower capacity (Ballot, 2016). Logistic and freight forwarding companies - which often act as subcontractors - are at the heart of this problematic. They are also at the cross-roads of retail and e-commerce as their infrastructures (trucks and warehouses) are a critical link from production to end-customer either via traditional or on-line retail (Rashbrook, 2017). Their main contributions in regards to sustainability are on fuel efficiency [39](through vehicle fleet matching the highest standards and through driver training to eco-driving), cargo optimization through adaptation of truck to bulk density and reverse logistic. Some large freight forwarders are even working on cube optimization by developing optimal secondary packaging for their customers (XPO Logistic, 2018).

3.2.3 End of Life and Recovery

Products or material end of life can happen at any stage, from production to final use. Recycling of production waste is a reality since years in packaging industry: at converters for corrugated (Confederation of Paper Industries, 2017) and directly at production sites for films extruders (Dirnberger, 2018). Once again; this trend is more geared by economic (waste is a cost) rather than environmental motives. Modification of productive equipment is generally required. Waste sorting and collection occurs at each step of the full supply chain: from FMCG production sites until retail stores or consumer home for e-commerce. Obviously, several regulations apply. If an industrial, logistic or large retail site is under the “economic activity waste” umbrella (art R541-8 of “Code de l’Environnement), urban area small store waste is assimilated to household waste (art L2224-14 of “Code général des collectivités territoriales”) (Haeusler & Berthoin, 2016). It is disposed together with primary packaging and e-commerce packaging waste. This difference of applicable waste management plays a key role in waste recovery efficiency. The traditional simple and limited material of logistic packaging is then mixed with household waste which is by far more heterogeneous (and not covering flexible plastics until end of 2022[40]), thus complicating recyclable material identification inside the sorting flow and generating high rejection rate of in average 35%, all this contributing to a lower recycling rate (Haeusler & Berthoin, 2016).

Waste sorting inside industrial, logistic and large commercial facilities is generally well organized as it is a legal requirement and an operational necessity.

[37] CO^2 emissions scopes: scope 1 include all direct emissions linked to manufacturing/distribution; scope 2 includes all indirect emissions linked to energy production; scope 3 includes all other indirect emissions, up and downstream

[38] Source FEVAD : based on a sample of 40 million parcels delivered by 20 freight forwarders (https://www.60millions-mag.com/2016/11/29/livraison-domicile-pourquoi-tant-de-problemes-10811)

[39] In last 20 years, road freight emissions of polluting gases decreased by 80% and fuel consumption/ton decreased by 20% (source FNTR)

[40] Eco-Emballage/CITEO extension des consigne de tri

If recycling remains the best option for packaging waste, other solutions are in place, depending on the source location (proximity or not to sorting facility and/or waste incineration plant) and the associated waste collection organization. Thus, industrial factories in rural areas not equipped with sorting and/or incineration infrastructures might well see their waste going to landfill (Haeusler & Berthoin, 2016). Although not ideal, energy recovery can represent an acceptable alternative to landfill with two favorable effects: it reduces both long-term waste impact on the nature and use of fossil fuel for energy production (Sustainable Packaging Coalition, 2011). Landfill still exists and remains the #1 waste downstream channel in France with 28% (direct allocation but 34% after re-allocation of other channels), before energy recovery (25%), and recycling (20%), the remainder being split among composting and methanization. In addition, among the 35% of waste not accepted after sorting, 15% is going to energy recovery and 20% to landfill (Haeusler & Berthoin, 2016).

3.3 Challenges of Sustainable Logistic Packaging

Fulfill the circular economy requirements while being economically attractive remains the main challenge, especially in the Consumer Goods highly competitive environment. But sustainability is a very wide and complex topic as it encompasses all factors directly or indirectly influencing natural resource, environment preservation and human protection. Even restricted to logistic packaging, it requires a deep knowledge of materials, flows, interactions and interconnections between industrial, commercial and waste management to be able to properly address this subject.

Although sustainability aspects are known to and expected by packaging buyers, they do not prevail. The top 3 packaging criteria according to (Conseil National de l'Emballage, 2017) (several choices possible):

- Product protection / cargo safety
- Freight and storage fit
- Marketing and customer information
- Costs and cost reduction
- Ecology / recyclability

All these points are strong expectations but sustainability aspects come #6, corroborating all testimonials and observations: economic considerations come ahead of sustainability. Additionally, a recent study[41] showed that 40% of purchasing managers considered sustainable purchase as a priority while 60% as just one element among others. There is a gap between the mid- and long-term corporate willingness and commitments to converge towards sustainability (Tebbe, 2017) and the short-term (daily) basic objectives of operations. This is making more difficult to push sustainable solutions based on corporate policy since operations are quite disconnected from Strategy and purchasers focus on price and functionality matching a given target to achieve at quarter-end (Saporta, 11/2015).

Last hurdle but not the least is the numerous actors along the value chain that would be affected by a change, from packaging manufacturers and converters to logistic providers, from industrial and retail to

[41] Opnionway pour l'observatoire des achats responsables – baromètre 2018 (Fev 2018)

waste management companies (Rao, 2013). To overcome these difficulties and allow all players to collaborate on these global issues (among which sustainability and environment) without impeding competition, the Consumer Goods Forum was created in 2009. Since then, many workshops have been held between all industry contributors and guidelines issued to support transition towards more sustainable packaging (Consumer Goods Forum, 2011).

The full "6 RE Philosophy" mentioned by (Remmen, Landfield, Saur, & Astrup Jensen, 2006) is an approach that can be applied to reach better packaging sustainability.

Re-duce

From a sustainability standpoint, the best packaging is the packaging that never existed. Is it feasible? Not really because products need to be protected throughout supply chain. If suppression seems not to be an option yet, reduction is in many roadmaps.

Reducing but keeping the same convenience and protection functionalities is a real challenge but a key success factor for logistic packaging. Optimum use would imply less material, to reduce direct and indirect (production and transport) negative effects. This is generally achieved through eco-design. Eco-design is mainly used for primary packaging, triggered by eco-contribution, consumer perception and high direct costs. Marketing still prevails in primary packaging design of consumer goods, especially when sales erosion needs to be countered by product evolution; this includes additional primary packaging, totally in contradiction with sustainability targets (Jadoul, 2015). It is also used for secondary packaging, specifically for pallet optimization or for SRP packaging. Sometimes eco-design also leads to material switch to gain volume and weight. However, some new materials introduced do not necessarily match recycling criteria. Eco-design should integrate the current recycling infrastructure (under-capacity or non-existing) for new products (Sustainable Packaging Coalition, 2011) as a truly sustainable solution should be valid today and not in a hypothetical future.

Packaging reduction – or more precisely packaging/product ratio optimization – constitutes the quickest and sometimes easiest route to sustainability, given the transport and storage GHG impacts. Higher density of products achieved thanks to secondary and tertiary packaging will mechanically impact favorably truck loads and storage capacity. Pallet optimization can be achieved with improved filling and more technical corrugated (thinner and stronger) and films (thinner and stronger) that will impact weight (improved gross/net weight ratio) as well as reduce logistic packaging waste. Optimum use would also imply re-use. But reducing weight is contrary to extended lifetime: to be used several times without needing adaptation or repair, a packaging needs to be stronger. Its weight and therefore CO^2 emissions linked to production and weight transported are impairing the sustainability equation. So if reduction cannot be achieved, then increased functionality at same cost should be targeted. The concept of SRP seen previously finds its origin in this approach. Combination of logistic packaging with optimum handling and point of sales display of valuable information for customers are key features of SRP (Conseil National de l'Emballage, 2017) & (Efficient Consumer Response Europe (ECR), 2007). SRP can sometimes

be a single use (when dedicated to a special promotional action at printed accordingly) and then could be re-used for corrugated waste evacuation (see pictures).

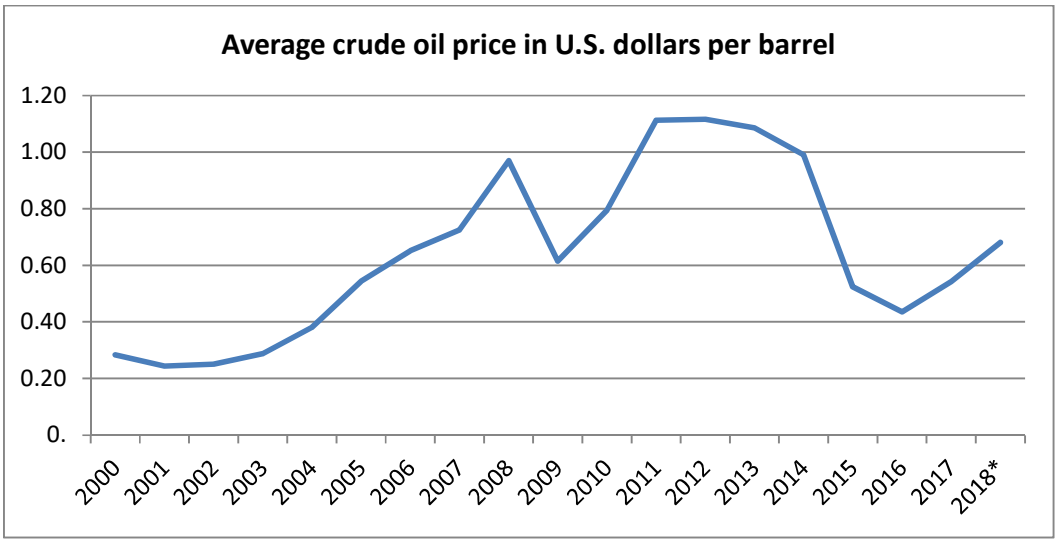
Re-cycle

Recycling is already a reality in many industrial or commercial locations. Infrastructures are in place almost everywhere; but where they need to be developed, it will require time and money. Optimizing recycling and making it possible everywhere can represent a benefit for both environmental and economic dimensions of sustainability. Current push in France is made on household waste. New approach will be needed in order to maximize industrial and commercial waste recycling through closer loops.

Some sectors are well organized and achieve already an optimum level of recycling. Pallets are a well identified re-usable packaging. They are managed in pools by industrial, pallet rental companies of 3PLs. they can efficiently be allocated to re-use, re-pair or recycle (Roussel & Svilar, 2015). Corrugated boards flows are also well identified and structured allowing allocating more than 90% to recycling (Haeusler & Berthoin, 2016). Plastic recycling volume is largely behind, due to complexity. Heterogeneity of feedstock (7 plastic families[42]) and incompatibility preventing mixing resins between themselves for recycling is hindering recycling. The current French plastic recycling industry is not able to absorb all volumes because if its lack of infrastructures (Dadou-Willmann & Harscoet, 2014), which is becoming a concern due to new plastic flow arriving in recycling. The target of 0% plastic in landfill (Jadoul, 2015) and the 100% plastic recycling (Demoux, 2017) could seem ambitious given the current situation of this industry.

French recycling infrastructure for plastic faces large under-capacity problems, representing only 6% of total European of flexible PE (Plastic Recyclers of Euope (PRE), 2018), explained by several factors. The high cost structure linked to plastic feedstock collection, sorting and preparation for recycling that cannot be covered by revenues generated from sales of recycled resin; export of plastic feedstock to countries with significantly lower labor costs (Dadou-Willmann & Harscoet, 2014) given the labor-intensive necessary activities; low recycled plastic demand in Europe (6% of total plastic demand) (European Commission, 2018) & (Demoux, 2017); few opportunities for recycled resins as virgin materials have regained competitiveness linked to low(er) oil price since 2015 (Saporta, 11/2015).

[42] See appendix 8.6



Source = OPEC by Statista

Recent events with China ban on waste import (Golla, 2018) vindicate this state of things. This situation created an overstock of collected waste resulting in a significant drop in recycling feedstock price - This was already the case in 2012 when Chinese recyclers focused on local rather than import sourcing, creating at that time a price drop in PE and PET recycling raw materials (Actu-environnement, 2013). History is repeating itself.

Stretch films can incorporate a maximum of 30% of recycled resin (ELIPSO, 2015) which is a limitation factor for recycled material use in a full closed loop. Same issue than with corrugated is faced but with a much higher proportion of a non-sustainable virgin source. However, PE films can fully be recycled for other applications like waste bags (ELIPSO, 2015). Plastic film recovery still presents some room for improvement, with for 2014: 2% re-use, 19% recycling and 53% energy recovery (ELIPSO, 2015). Recyfilm is the French eco-organism created in 1994 and devoted to flexible plastic recycling. After 20 years, achieving 19% recycling could be considered as a mediocre result but many factors explain this situation. First, plastic sorting is labor intensive and difficult because resins cannot be separated visually. Because of this, collected plastic in industrial and commercial channels was firstly sent to China benefitting from low labor costs, existing recycling infrastructure (China developed this capacity to reduce its oil dependency) and low sea-freight fares opportunity[43] (Dadou-Willmann & Harscoet, 2014).

Re-place

Starting point is the raw material used for packaging production. A sustainable packaging should be sourced from recycled or sustainable and renewable virgin origin, ideally traceable. In France and Europe, it can be considered as achieved for wooden pallets, corrugated and metal (pallets & roll cage)

[43] Europe-Asia sea freight costs equals road freight of few hundreds kilometers

since these sectors are well structured and organized for sustainable sourcing or virgin source[44] or recycled (Haeusler & Berthoin, 2016). For plastics, being mostly a fossil-based material, it is a more challenging topic. Hence, 100% sustainable cannot always been achieved but it can be pursued. Replace for a more sustainable product i.e. that is contributing favorably to the total equation might well be challenging. Any substitution that is improving one part but deteriorating another one cannot be considered sustainable. When developing or introducing new materials, awareness about recycling technical constraints, existing technology and infrastructure capability make the difference between theory and real life.

Bio plastics, although growing, are still not very well spread as the heavy investments in R&D and production capacity are harming its cost price. It is influencing selling price with a premium of 10 to 20% compared to oil-based materials (Rao, 2013). Its lack of competitiveness compared to traditional plastics is the main obstacle to development in a market dominated at 99% by oil based products (Huynh, 2015). Bio-plastics can be mixed with oil-based resins to produce packaging films. They can also be recycled together. Bioplastics do not necessarily mean bio-degradability and biodegradability does not necessarily mean recyclability. If bio-degradable plastic seems appealing, it might not be such a good idea; because bio-degradability conditions could not be met in nature, bits of micro-plastics could be found and ingested by wildlife (European Commission, 2018). Bio-plastics would therefore not deliver the promise of a cleaner nature. Bio degradable plastics could in addition be incompatible with recycling specifications of oil-based or bio-plastics because of the additives necessary for their bio-degradability characteristics. Bio-plastic application for stretch; shrink and strap represent an available alternative that will continue to grow at a pace indexed to the oil-based product prices.

But it is not only about replacing products. It can also be about replacing suppliers. A supplier being committed to sustainability through various approaches and certified accordingly like ISO 14001, ISO50000 for energy efficiency is preferable to a supplier not being certified.

Re-Use

Re-use applies to all or part of a packaging. E.g., for a packaging made of a box and a lid, box can be reused but lid disposed. It would still contribute to improved sustainability.

Development of returnable or multi-purpose packaging is also a growing trend among the industry.

Re-use can be apprehended in three main ways. First, in a closed-loop approach where packaging is coming back to its point of departure in order to be re-used for the same purpose. This is the case in retail for roll cage trolleys or some ready-to-sell boxes (SRP) for fruits and vegetables. Then, in a semi-closed loop approach where packaging is coming back to a pool for re-use (like pallets) or to the sender for finally disposal (like of e-commerce returns). Finally, in a fully open loop approach where re-usable packaging is totally changing its primary destination and can be re-used for any other purpose by the packaging holder. *E.g. the Nespresso delivery box than can be re-used as a shoe box.*

[44] PEFC and FSC for wood sourcing, see note 17

Additionally, re-use often implies sometimes dedicated storage space until collection and a reverse logistic scheme. But returning an empty packaging is sub-optimal for freight efficiency. This is why many solutions aim at reducing the volume of an empty box (collapsible box, efficient stacking). And the efficiency of the scheme lies as well in the quantity of packaging collected. While re-using is the basic business model for pallets and cage roll trolleys (generally used in pools for greater efficiency and flexibility), it is starting with box-pallets which can be considered both logistic packaging and SRP.

Re-pair

Repair is linked to re-use; it allows maintaining packaging into best working conditions to fully deliver its potential. But in order to have a packaging easily reparable, it needs to be "re-thought" and designed in such a way. This is only viable for high value packaging like metal trolley or plastic pallets or pallet-boxes as well as with high volumes of a very standard product easily substitutable like pallets. If re-use is planned to grow, then re-pair will as well. But evolution of supply chain – especially reverse logistics – needs to be studied to ensure non-functional packaging enters the repair flow in an optimized way. GHG balance and cost of repair should not exceed the ones of disposal.

Re-Think

Re-think is not limited to the product per se but includes the functions rendered by logistic packaging. Rethink the tandem product/packaging, optimize its ratio are among the possibilities often addressed. Not only should raw material be considered but the whole GHG impact along the value chain, starting with packaging material. Additionally to sustainable sourcing, corrugated industry is working to reduce production process GHG emissions. This industry needs high quantities of energy to process raw materials and manufacture products. It is estimated at 25% of total costs (Rao, 2013) – not to mention use of natural resources like water. This is why paper and corrugated industry has long ago started its conversion to biomass in order to step away from fossil fuel based energy (Smurfit-Kappa Group, 2017). When looking at the full global approach of CO^2 emissions, plastics are far less emitting GHG during transformation process as it requires less energy. GHG equation is unfavorable looking at raw material only but it is partially compensated by process when looking globally. Additionally, plastic film is very light and the product/packaging ratio is much more beneficial to film than corrugated[45].

Re-think the supply chain until the very end is a difficult topic. However, it should not be forgotten that logistic packaging induces grouping of homogeneous products while e-commerce packaging induce unitary /small groupings of heterogeneous products, with quick delivery and easy return functionalities (Fischer & Lilienfeld, 2017) & (Rashbrook, 2017). Transit packaging is optimized to the goods for FMCG to retail while e-commerce packaging is sub-optimized, being a trade-off between management of a certain number of packaging references (variety) and best suitable size given packed goods[46]. This difference will influence the typology of cross-business solution (Fischer & Lilienfeld, 2017). For a more efficient logistic

[45] no detailed LCA were available to perform a comparison between the various options
[46] "Packaging and the Internet: a guide to packaging goods in multi-channel deliveries", incpen, 01/2012

packaging serving both retail and e-commerce at the same time, best would be differentiation at the very end of the chain.

Today's investigations and tests into in-store shopping for internet customers and foot-deliveries or "drive-in" or "walk-in" pick-up[47] would solve several issues at the same time: CO^2 footprint of urban logistics for individual deliveries and better store replenishment with optimized truck rather than half empty trucks for internet deliveries. Additionally, it contributes to optimization of inventory and inventory turn avoiding dedicated stock for each channel thanks to a shared stock between physical store and internet offer. Logistic packaging in this case becomes a shopping bag or a disposable corrugated box or re-usable plastic case.

But re-think projects currently deliver only incremental innovation contributing to better sustainability.

The "Physical Internet" (PI) has the potential to revolutionize logistics and contribute to enhanced sustainability of the supply chain. This disrupting open-innovation project is based on 2 observations. First, logistic, the second biggest GHG emissions factor is totally under-optimized. Second, sea-containers disrupted world trade by allowing transporting any goods in a standard box. In the light of this, university researchers elaborated a two-fold concept. Standard containers of various sizes are managed independently from cargo. These containers are moved in the supply chain using a standard and shared open IT protocol. This concept originated from applying the internet way of working to logistic physical flows: to transport standard packages of goods (like data) across a network avoiding point to point deliveries and allowing optimized transportation and transshipments between big logistical hubs. This project is managed by scholars from various universities around the world, in North America (USA, Canada and Mexico), Europe (France, Austria, Germany, UK...), Africa (Morocco) and Asia (China and Korea) contributing to a research network. It triggered the interest of FMCG and Supply Chain players which are also supporting and monitoring this initiative. As an example, Consumer Goods Forum was an official sponsor of the 4th international Physical Internet Conference in 2017. Procter & Gamble, FM logistics and Chep[48] are also participating to workshops. The (Ellen MacArthur Foundation, 2017) is also promoting this project as it advocates shared re-usable packaging delivering 32% overall cost savings linked to better filling rate and up to 60% GHG emission reduction (Montreuil, 2017). This could even totally revolutionize the current logistic and associated packaging that dominates today (Ballot, 2016). The concept is highly technical and complicated. It implies conception of a full set of modular containers (potentially embarking IoT[49] devices) and development of software dedicated to cube optimization, container management for freight and transshipment in distribution centers. Modularity of the PI could also enable serving both retail and e-commerce (including "last mile") at the same time (Ballot, 2016). The whole challenge of PI project is to create an open-source standard that will then be adopted by the majority of the supply chain players. Supply Chain would then operate in an inter-connected network contrary to current situation with proprietary systems that do not allow full inter-operability. A universal system based on intermediation platforms would create a network economy, which would bring higher benefits than economies of scale (Ballot, 2016).

[47] Walk-in piéton: today available from Leclerc, Carrefour, Intermarché
[48] Chep is a company specialized in packaging rental (pallet, plastic boxes)
[49] IoT stands for Internet of Things: connected objects collecting data like localization, movements, temperature …

PI is currently moving from the research and simulation field towards physical testing. One application project, Modulushca has received EU funding to test a concrete proof of concept for the PI, demonstrating its relevance, feasibility and viability. Other test projects are taking place in North-America [50]. However, PI project is not foreseen to go live anytime soon. Time framework is 2016-2020 for research program while testing could extend to 2030[51]. Then various steps are planned until 2050 for a fully operational PI[52], if it ever goes live. But it would anyhow have contributed to a different way to apprehend logistic packaging and FMCG supply chain.

Sustainability is a challenge for the whole economy and not only for logistic packaging. What the literature studied and presented has evidenced will be complemented by results of interviews and field observations.

[50] http://www.modulushca.eu/index.php/the-project/objectives
[51] Source = Modulushca: http://www.modulushca.eu/
[52] Source = Road Map Physical Internet ; http://www.etp-logistics.eu/

4 Methodology

To perform this study, various sources of information have been used: both primary such as personal interviews of packaging experts, as well as waste management or sustainability experts, producers, retailers and industrial users, and secondary like academic research and publications on sustainability by governmental, supra- governmental and non-governmental, professional journals and websites.

However, interviews were more difficult to execute than anticipated. Persons interviewed represent the whole chain from packaging manufacturer to waste management, including packaging distribution sales, food FMCG purchasers, packaging experts, sustainability managers, and retail. With only few (9) respondents[53], information given will be qualitatively good given the profile of interviewed people (appendix 8.5) but representativeness could not be guaranteed. Therefore, qualitative contribution will be reflected but cannot be generalized as a trend among one industry.

Interviews were preferred to questionnaires in order to leverage contact, capture more qualitative data and be able to better apprehend the focus given to sustainability and evolution, blocking points regarding logistical packaging. Interviews were not recorded. Manual notes were taken.

Collected data has been sorted by theme in order to present and compare answers from the different players of the value chain on specific topics. This allows apprehending the different viewpoints on the same topic.

Field visits and observations were also used in order to corroborate information received with real-life experience. Around ten urban area stores of food and non-food distribution were visited. Store sizes range from less than 100m² up to 8.000m². This wide range of surface allowed observing different practices when it comes to consumer goods delivery, storage, shelf placement and waste evacuation. Some pictures in appendices are illustrating the different business cases met in these stores.

Secondary data are mostly coming from well-known official and reliable sources such as Ademe[54] or professional association publications (e.g. Elipso, Eco-Emballage, Sypal, Conseil National de l'Emballage[55]) as well as some press articles to demonstrate connection to current news and events. Smithers-Pira's[56] market reports and prospective analysis supported also this study.

Some technical data regarding pallets, stretch and shrink film recycling process rely on information presented by commercial companies during professional thematic conventions.

[53] See appendix 8.8
[54] Please refer to appendix 8.6 for more information
[55] Please refer to appendix 8.6 for more information
[56] Smithers Pira is considered the worldwide authority on the packaging, paper and print industry supply chains with more than 80 years' experience and regular market prospects publications.

5 Key findings

5.1 Logistic Packaging Sustainability: a soft focus from FMCG and retail

FMCG industry is among the most dynamic on sustainability topic, going beyond the regulations and relentlessly challenging this topic. They even embark suppliers in this journey. For example, L'Oréal ask its key suppliers to fulfill the CDP questionnaires to continue cooperating (Malpièce, 2018). In order to efficiently address these issues, FMCG rely on internal resources as well as on partnership with focused organization such as Ellen MacArthur foundation or Consumer Goods Forum (Bousquet, 2018). Nevertheless, the focus on sustainability aspects of logistic packaging does not prevail among economic or practical aspects.

Retail chains main expectations regarding logistic packaging are manifold (Swiderski, 2018) & (Badouix, 2018). First and foremost, it is to protect products until shelves replenishment and avoid non quality costs resulting from damaged - therefore not sellable – goods. Damaged products - including originated from logistic packaging failure - can result in food waste which is no more accepted from ethical and economic standpoint. Secondly, it is to allow efficient logistic in order to keep as low as possible workforce handling costs while maximizing in-store product availability and shelf optimization. The cost of transit packaging is insignificant compared to the value of the products it protects and the cost of damage it could generate (Trohay & Lucot, 2018). Yet, it is often considered as a commodity product with a very strong cost focus from purchasers (Bigot, 2018). There is no willingness to pay an extra premium for having a sustainable solution, unlike in private individual behaviors[57]. Therefore, all options have to bring in the first hand economic advantage, environmental benefits being the cherry on the cake (Swiderski, 2018). Consequently, Industrial and supply chain efficiency and cost optimization are the motors for challenging the logistic packaging (Badouix, 2018).

Logistic packaging is currently out of the Extended Producer Responsibility (EPR) scope. To encourage better results and structure a dedicated sector, broadening of EPR to secondary and tertiary packaging is envisaged but under different format, not well defined at this stage (Trohay & Lucot, 2018). However, nobody would welcome such new disguised taxation. Industrial and retail waste and recovery sectors already exist and do not need an extra technocratic layer to properly work (Swiderski, 2018).

Current sustainability focus of industry is mostly on qualitative sourcing and primary packaging optimization. Three main raw materials are under specific attention at Danone: water, milk and plastic. A fully empowered team of 25 purchasers based in Amsterdam is focusing on optimization of these three "cycles". Two circular-economy experts are embedded into this team (Bezati, 2018) and concentrate on recyclability of plastics, incorporation of recycled content and bio-sourced materials. Reduction of primary packaging brings direct and indirect cost benefits through decrease of both material and eco-contribution costs. Secondary and tertiary packaging being excluded of the extended producer responsibility, their optimization only brings material cost benefits. Additionally, the cost ratio primary/secondary packaging is detrimental to the latter, another argument for concentrating on primary packaging optimization (Bezati, 2018). However, it would be untrue to say logistic packaging is

[57] https://www.rse-magazine.com/Les-consommateurs-sont-prets-a-payer-plus-pour-les-produits-des-entreprises-responsables_a2220.html

not in the focus. Indeed industry and retail are focusing on their real sustainability issues like energy consumption (production and temperature driven storage and transportation), freight, food waste and primary packaging. But there is a rising awareness about logistic packaging in terms of quality and costs. If it does not yet trigger concrete action plans in terms of sustainability (Bousquet, 2018) & (Bezati, 2018), FMCG companies are building knowledge resulting in increased awareness, a preamble to action. And Danone wants to play an active role in promoting more sustainable options in all areas – including logistic packaging. As a committed (and powerful) ordering customer, Danone can push suppliers to integrate a certain quantity of recycled content or set-up circular-economy based solutions, as long as the economic equation works well (Bezati, 2018).

5.2 Logistic Packaging CO^2 emissions: a notable absentee

Concentration on other sustainability aspects leads to an incomplete knowledge of logistic packaging GHG footprint. In a consumer good product LCA, both secondary and tertiary packaging are included, but not for their entire footprint unlike primary packaging, but only for shipping and transportation from production site to product packing site and then down the supply chain until end of life (Hugrel & Palluau, 2014). Therefore, its impact on the total product is minimal, as anticipated in interview with (Trohay & Lucot, 2018). In FMCG, there is a big disparity on CO^2 emissions assessment and reduction targets. Logistic packaging is included into scope 3, the indirect emissions[58]. In their declaration obligations, companies must choose for the biggest CO^2 contributors in order to cover 2/3 of their indirect emissions. This includes generally purchasing of raw material, freight and primary packaging. (Malpièce, 2018) never saw logistic packaging in official declaration so far. But regulations are evolving and getting more stringent. Industry will have to adapt sooner or later (Malpièce, 2018). This could be a driver for change of behavior.

Another point of interest encompassing logistic packaging is the convergence of traditional retail and e-commerce. It is driving logistic packaging evolution in a search of innovative solutions fitting both smaller unit loads and mass-retail at the same time These common solutions would allow physical and on-line retail to benefit from economies of scale by serving simultaneously and identically the two channels. This approach is on the agenda of retail. But it is not yet an active topic as more short terms improvements are getting attention of the small team (Swiderski, 2018).

This apparent lack of interest should not overshadow all concrete actions, already in place or up-coming. For example, working on flow optimization delivers substantial benefits. Thus, direct store delivery and cross-docking are delivery patterns allowing efficiency through reduced freight and handling.

Sustainability is often assessed by the packaging industry with easily measurable KPIs like weight reduction, recycled content and recovery rate of post-consumption packaging. This approach totally ignores all gaps between theory and reality and all the undesirable indirect effects. Only a LCA approach can truly evaluate what the impacts are. On upstream side, film producers and converters consider that they are sustainable as they sell 100% recyclable products and they recycle production waste; they do not conduct specific discussion about this topic during selling process: “it is a common understanding

[58] See Note 37

and there is no necessity to underline this aspect during negotiations" (sic) (Moroni, 2018). LCA approach was considered not necessary (Moroni, 2018).

However, LCA presents some limits and speaking about an approach to LCA would be more appropriate (Malpièce, 2018). Technically, a LCA calculates CO^2 footprint of one product manufactured in one production plant and delivered to one point of sales utilizing one defined supply chain. If one of the element varies (type of truck, different distribution center …), the LCA is not valid anymore (Malpièce, 2018). Considering that LCA is rather expensive, generally giving only indications but no solutions, it is conducted on some star products (Trohay & Lucot, 2018) or on very specific topics (Swiderski, 2018), but never systematically on the full range, and never with logistic packaging included.

FMCG companies are generally purchasing their logistic packaging through a tendering process, sometimes with international perimeter (Bigot, 2018) & (Rapp, 2018). They often include in their specifications sustainability criteria regarding sourcing and recyclability. These sustainability criteria have to be met (and proven) to participate to the tender. They can be checked through an audit and document review. However, recyclability criteria depend about where packaging is disposed. This aspect remains partly theoretical. (Rapp, 2018) confirms that end of life or LCA and GHG footprint never come as a priority element during discussions, when this topic is ever mentioned at all, unless introduction of new packaging material could lead to perturbation in waste flows. Only products' performance, availability and cost are at the heart of negotiations (Rapp, 2018). But these aspects can result into an indirect increase of sustainability criteria. A joint work with raw material suppliers is conducted in order to minimize logistic packaging usage (Trohay & Lucot, 2018). Although people safety and cargo stability remain on top of the list, studies are conducted in order to optimize pallet height, reduce interlayers and favor recoverable materials. Re-use is the growing trend for logistic packaging in B2B[59]. It can be done in all the steps of the supply chain. Thus, primary packaging deliveries are more and more done in re-usable logistic packaging. This is the case for example of preforms or bottles delivered in metal pallet-boxes or shuttle corrugated boxes (Trohay & Lucot, 2018). It is also expending in store deliveries. Use of Roll-cage trolleys or reusable foldable boxes in fruits and vegetables are taking greater importance (Swiderski, 2018). However, utilization of re-usable hoods for pallet or trolley was not successful. Many hoods were lost or damaged. Management of re-usable packaging may be sometimes difficult. Re-usable packaging development contributes to reducing waste at each step of the supply chain, an important aspect in FMCG. Indeed, specific focus is given to waste management as it has become more and more important in quantity within all industrial and commercial premises. Waste collection and recycling/recovery are intimately linked to sustainability as they constitute the only way for decoupling growth from non-renewable resource consumption.

5.3 Logistic Packaging waste management and recycling: the Achilles heel

In all industrial premises, a first and simple focus is made on raw material efficiency. Any production process generates manufacturing scrap. It can be either disposed or recovered directly in production. This scheme is widely used in corrugated as recycled material incorporation is embedded into production process. But for plastic extrusion, it cannot be done without slight adaptation of production tool. An

[59] B2B: Business-to-Business = commercial activities among professionals.

example is specific capital expenditure of EUR 2m made in a stretch film facility in order to reintegrate production waste into raw material flow. Thanks to this, virgin raw material has been spared as well as all transport costs and emissions. A payback of 6 to 7 years could be achieved, a long time for financial standards (Moroni, 2018). This demonstrated that common sense and sustainability could sometimes take precedence over pure economics.

But waste cannot always be recovered in such a short closed loop. If final waste is a cost, recoverable waste can generate revenues. This motivates setting-up of specific sorting processes and targets. Thus, for example, General Mills has set targets for production facilities of 0% waste in landfill and 10% in energy recovery in order to gear maximum of waste towards recycling. This ambitious target is sometimes difficult to achieve as waste collection can be unsuitable, especially in remote production sites (Trohay & Lucot, 2018). Waste flow to the compactor is under the responsibility of operations (Singier, 2017). It is not unusual to observe that this action is not executed timely and efficiently, resulting into bin spill-over (picture 9). The different nature of products (boxes, films or strapping) leads to volume under-optimization in collection bins. As plastic films are hardly compressible they quickly come back to initial volume and fell of waste bins. This could divert packaging films from recycling to common waste. This issue is partially covered with waste compactors but all upstream flows suffer from this characteristic.

In-store waste sorting has many constraints. Space and waste evacuation can be critical - especially in high density urban areas. Store waste can be divided into 4 categories: bio-waste, corrugated, plastics and all the rest. Bio-waste is coming from non-packed food waste un-proper for consumption. It is allocated to methanisation to produce fuel used in delivery fleet. This is a good example of a circular application recovering waste and sparing fossil-fuel. However, bio-degradable packaging should not be added to bio-waste methanisation process as it deteriorates significantly yields (Swiderski, 2018). Shelving products generates secondary and tertiary waste (generally corrugated and films) inside a shopping area. It can disturb customer experience as it occurs during opening hours. Waste collation can be done on a wooden pallet or re-used box-pallet (pictures 7 & 8) in order to later be moved to waste processing areas in the back-shop. There, corrugated are generally baled using a specific machine and plastics (all stretch and shrink plastic films) are gathered into large bags. All the rest goes with common waste. Cartons and plastics are removed every day either by waste trucks or, for smaller shops, by temperature controlled delivery truck in a reverse logistic scheme and sent back to warehouse. The valued materials (cartons) are then “credited” to the store waste management costs. Bio-waste benefit from a specific collection while common waste collection depends on classification of the site: either economic activity waste or household waste (Swiderski, 2018) & Monoprix Levallois.

Industrial and commercial waste is already pre-sorted on site. It is either compacted into a container or directly baled or remain in bulk before being transported to Waste Collector site. After weighting, compacted waste containers or bulk are emptied into an open area. Waste is sorted mechanically with cranes and manually in order to remove polluting elements (pictures 17, 19, 22, 23, 24). Then, sorted waste is feeding baling machines with homogeneous quality materials (picture 11). New bales of homogeneous quality are made for corrugated and plastic films. These bales are the trading unit for the recycling raw material market (pictures 20, 21, 25, 26, 27). When received directly in bales (corrugated

or plastics - picture 16) and after visual inspection, it joins the recycling feedstock – or the energy recovery feedstock for downgraded lots.

Each quality category obtains a grade (from low to high quality) from which recyclers purchasing price will depend; top grades get the better prices. Corrugated quality grades are very well defined (Groulez, 2018). According to norm EN643[60], corrugated is divided into five families, from 1.01 (poor quality) to 1.05 (top quality). Corrugated coming from supermarket is categorized 1.04, meaning very good quality. Market for good quality is fairly big as it is a key raw material for corrugated manufacturers. Nevertheless, presence of adhesive tape can be detrimental to recycling quality. Field observation allowed noticing that Picard-Surgelés employees for example remove tape from boxes in order to generate qualitative feedstock. Corrugated cores for stretch films and adhesive tapes can be recycled but at a lower grade than boxes because they contain glues and resin to strengthen their mechanical characteristics (Groulez, 2018).

For plastics, if criteria are not as structured, they are well-known and shared among professionals (Groulez, 2018). The first formalized specifications were issued by the (Plastic Recyclers of Euope (PRE), 2018)[61] in November 2017. They describe the material and the accepted external interfering elements in quality and quantity. Main pollutions are of two origins. Firstly, labels are generally glued on two faces (length and width) to ensure they are always visible, whichever way of the pallet. Indeed, pallet can be stored in racks with facing length and width, on the platforms shipping/receiving deck or inside trucks pallets can be stuck together (Trohay & Lucot, 2018) (picture 5). Abundance of labels repeating the same information degrades the quality of film feedstock for recycling (Groulez, 2018) & (Plastic Recyclers of Euope (PRE), 2018) (picture 24). Secondly, colored films are also downgrading quality. (Swiderski, 2018) mentions a difficult negotiation conducted between Carrefour and Coca-Cola to switch Coke's highly distinctive red shrink film around pallets to a white or natural film. In this case, the sustainability argument had weight in the balance of power between retailer and Brand Owner but it took some time to be accepted and applied. This question can also be addressed with water bottles pallets covered with blue shrink film (picture 5). It seems that all battles have not been fought or won. Even with retail Private Labels, no strict specification in terms of tertiary packaging regarding quantity or quality is required. Some indications are given but not imposed, allowing standardization of packaging process within subcontractors (Swiderski, 2018).

Indeed, quality of recycling feedstock is a major determinant of value. Therefore, ensuring the best recoverable material feedstock is a shared target for industry, retail and waste management. It directly influences the valuation of their waste, i.e. price at which waste collector purchase waste to waste holder. China waste ban (Golla, 2018) emphasized this aspect. By creating a sharp drop in waste demand, feedstock prices plummeted, challenging the balance between waste valuation as a revenue and waste flow separation as a cost. If waste sorting does not bring value, then additional costs to achieve good quality feedstock are not justified – only legal requirement imposes to maintain sorting (Swiderski, 2018). For example, plastic feedstock that could be valued at 50 €/t before is now costing 150€/t. 200€/t difference on the economic equation (Bezati, 2018). But this ban also created a recycling capacity surplus

[60] See appendix 8.5
[61] See appendix 8.6

locally. Ban eases and only concerns low quality feedstock. High quality feedstocks can still be exported to China. To enforce this ban, Chinese customs were sent to the port of Rotterdam to check quality of the waste feedstock before shipment (Groulez, 2018). Important rejection rate created an overstock of waste, leading to immediate necessity of storage. Since few recycling opportunities could be identified, significant portion goes now to energy recovery, a far less rewarding option (Groulez, 2018).

From the industrial and retail standpoint; waste management is fully delegated to specialized third-parties. Little control is operated by waste holders. They obtain from waste management companies the needed certificate about waste collected (quantity and quality) and its further destination (landfill, energy recovery or recycling) (Swiderski, 2018) & (Trohay & Lucot, 2018) & (Singier, 2017). But neither industrials nor retailers know exactly which recovery channel is used for their packaging waste. Waste management companies also keep a soft focus on the downstream allocation (Trohay & Lucot, 2018). It is a significant part of their profitability: recycling raw materials can be more or less well valued depending on demand but also about quality of supply. China ban had a collateral effect. Waste holders started to be suspicious about waste management companies' behaviors and profits when they realized that significant portion of waste was going to China for recovery (Swiderski, 2018).

Interviews and field observations confirmed that many improvement actions are undertaken by all players of the value chain, from sourcing to recovery. Nevertheless, low GHG impacts of logistic packaging make it less into focus than raw material, freight or temperature control. But there are still avenues for progress in this area.

6 Recommendations & Conclusion

Integrating the principle of circular economy with a viable economic answer seems the only path to the make a real breakthrough. It has to be simple and profitable to draw attention and interest as most of the stakeholders are concentrating on issues far more contributing to GHG emissions than logistic packaging. Solutions for a short-term impact are here but not yet systematic and still under-optimized. They need for a strong push to upscale and enlarge these solutions and make them become mainstream and retained by all players along the value chain, as advocates Karl Falkenberg, Director General for Environment at the European Commission (Bisgaard & Tuck, 2014).

In the logistic packaging market where all actors have the willingness to achieve sustainability but not the willingness to pay for it, building a competitive advantage can be achieved through differentiating innovation. Nevertheless, incremental innovation and operational excellence, although not bringing competitive advantage, can still support business development and profitable growth (Porter & Heppelmann, 2014). FMCG and retail are in a frantic race towards sustainability but cannot embrace all topics. Packaging distributor, with its specific positioning between packaging producers and users, can support this race on behalf of the consumer goods industry by appropriating this subject.

As a mirror to the key findings, let's investigate some possible answers or improvement ideas for a packaging distributor eager to grow its business and attract customers while contributing to a more sustainable world.

There are many hurdles to overcome to develop a more sustainable approach for logistic packaging. Not all are located inside the FMCG industry or in retail but could lie in any player of the value chain.

6.1 Sustainability exemplarity

As any other company, a packaging distributor willing to promote sustainability in its product, service and solution offer needs not to do it solely at customers and prospects. It has also to walk the talk and apply internally a global and ambitious CSR strategy. Focusing on carbon footprint, this would need an action plan addressing enhanced sustainability internally (operations) and externally (sourcing and offer to the market) in order to gain legitimacy and trust.

In the field of operations, B-to-B distribution is articulated around IT systems, warehouses and fleet of handling material, sales representative cars and delivery trucks. Thus, energy consumption, be it electricity or fuel, is an important variable cost driver. This cost base will mechanically and inexorably increase until 2050 due to Contribution Eco-Energie[62]. In order to foster the switch toward lower CO^2 emission infrastructures, a carbon pricing element could be included in the investment payback calculation (Berruti, Giorgi, & Morgan, 2017). This would not be just an artificial criterion but a true driver as internal carbon pricing is the anticipation of contribution evolution; because investments are meant to last over time, this anticipation can generate future financial benefits on top of environmental and business ones.

[62] See appendix 8.9

This conversion can be organized progressively with renewal investments. It can also benefit from tax incentive or cost reduction implied by reduction granted for special schemes with a payback on energy bill (Denuit, 2018) & (Berruti, Giorgi, & Morgan, 2017). As examples, delivery trucks using GNV rather than Diesel could be favored, avoiding business interruption in case of traffic restriction and making substantial economy on fuel price and consumption[63]. Company car policy regarding diesel, gas or hybrid could also be adjusted with the same motives. Energy for warehouse heating and handling material battery recharge could be supplied by renewable energy either purchased from a provider with a special contract or directly produced on site with solar panels or windmills. IT hardware could also be hosted in external or internal "green" server farms. All these actions would additionally influence the employees' sensitivity to sustainability.

6.2 Sustainable logistic packaging: a business approach

Looking at its environment, a packaging distributor could easily take ownership of the logistic packaging sustainability topic. It would relieve FMCG industrial, 3PL and retailers from this subject and packaging distributor could act as a global solution provider offering a "peace of mind" approach. Externalization of the logistic packaging function could act as a pain reliever and sustainability gain creator[64].

Packaging distributor is at cross-road between packaging manufacturers, FMCG industry and retailers. It does not rely on a single industry (pallet / corrugated / plastic packaging) but can created and integrate innovative solutions from various suppliers / partners. It is uniquely positioned to build a tailor made offer to the market. Sustainability could be a very distinctive feature to add to current service and product offer, which could grant a distinctive advantage versus competition.

The value proposition should be three-fold and articulated around products, services and solutions. All its components should bring economic benefits, in its widest sense to exit the price discussion. Global value delivered by logistic packaging can help substantialize sustainability and make it acceptable and accepted by customers.

The product offer must integrate multiple parameters. It has to include recyclable materials contributing to circular economy through recovery and recycling. The recyclability aspect should be assessed with current infrastructures. Given the nature of logistic packaging materials, they would easily fit into the criteria presented in appendices 8.5 and 8.6. For France specifically, it would participate to creating a bigger flow of qualitative materials towards recycling infrastructures, supporting the needed improvement of sector's profitability.

Products must not only be recyclable but must include as well recycled content. This recycled content has to come from post-consumption recycled raw materials. Only this source contributes to circular economy by creating business opportunities for raw renewable materials (RRM), unlike production scrap reintegration. This can be the case for almost all products.

[63] In addition, GNV vehicles can benefit from free car registration document
[64] Pain reliever & gain creator are part of Strategyzer Business Model & Value Proposition Canvases.

Bio-sourced materials should also be included in the offer. Even if price still remains high and often uncompetitive, it should be proposed as an alternative to virgin or recycled source. Few customers might want this kind of products. Promoting this source of product will also contribute to reach higher volumes and help decrease prices.

In the area of machines, specific focus on energy consumption shall be given. Energy efficient machine range should be proposed in order for companies deploying ISO50000 to find packaging machines suiting their requirements.

Materials and machines contributing to the circular economy scheme should also be added. Articles relating to waste management such as big-bags, waste containers, baling machines, shredders… should supplement the product offer in order to support customers truly targeting a global environmental achievement.

A packaging distributor cannot suppress from its range products considered as non-sustainable on the grounds that it is promoting a "green" offer. The two offers have to coexist simultaneously as not all customer-base is interested in purchasing sustainable products. For each product proposed, a sustainable alternative must be available.

The service offer is complementing and enriching the product offer. Its objective is to support customers or prospects achieving their sustainability targets. Various services can be proposed:

- Packaging material support: help selecting products totally compatible with recycling requirements. Packaging distributor can contribute through advice and consulting approach to reducing or eradicating non-compliant materials (tinted films, large labels) that could contaminate a homogeneous and qualitative recycling feedstock.
- Packaging Eco-Design: Eco-design is an interesting feature of incremental innovation: existing solutions to be improved and extended. Eco-design would better anchor the customer connection by building a relationship based on partnership rather than customer/supplier. Box and pallet optimization (also known as cube optimization) would help maximizing the product/packaging ratio. It would mechanically result in freight efficiency by reducing CO^2 emissions (Bisgaard & Tuck, 2014). This area is as of now covered either by box manufacturers or by some freight forwarders. Packaging distributor could rely through sub-contracting on already existing capacity or either builds its own. A mixture of both can be envisaged: start with sub-contracting and when enough projects allow reaching a critical mass, build the internal capability.
- Packaging environmental impact: measure and supply customers and prospects with GHG emission estimation either on a selection of products or on specific products. This can be useful for customers willing to integrate this element into their "scope 3" declaration[65]. It can also simply allow selection of least impacting product. This would grant packaging distributor a mean to perform benchmark

[65] See note 37

about the “greenest” offer, integrating all the product life cycle. It can also support starting discussions with suppliers about improvement plans.

- Packaging communication toolkits: in connection to eco-design, prepare ready-to-use communication sets about logistic packaging optimization and associated CO^2 impacts. It can support the brand image towards more sustainability in order to inform consumers and eventually help conquer or retain customers. Since use of environmental claim about packaging is quite restrictive, this communication would be limited to in-store or website communication. Weight and/or waste reduction and freight optimization could be claimed and understood by consumers[66]: people can better visualized and understand an argument of “–X trucks on the road” rather than “–Y tons of CO^2 emissions” or “–Z tons of virgin plastic saved”[67].
- Carbon Offset: When looking at CO^2 emissions directly linked to logistic packaging life-cycle (from production to end-of-life), carbon offset could also be proposed. Carbon compensation (or carbon offset) can be considered as an easy way to buy “clean” consciousness by offsetting the CO^2 emissions through financing of an accredited project. But does it drive behavior change toward true sustainability? No evidence is made as this system allows keeping current non-sustainable behaviors (Fragnière, 2009). It surely can be envisaged as a first step in the direction towards sustainability, but it cannot entirely be considered as a final or long term solution. However, when no carbon-free alternative is available and applicable within a short period of time and at an economical acceptable level, carbon offset is the only way to transform a non-sustainable option into a (more) sustainable one. This can be the case, among others, for plastics (until 100% bio-plastic gets to an economical viable level) or transport (until clean energy for mobility has been generalized). It can be proposed as a service to companies willing to offset their CO^2 emissions together with a sustainable product offer. In order to be able to make a “Green Offer”, the companies should know the carbon footprint of each of its products. Only an approach by main family can be seriously envisaged (Malpièce, 2018) because detailed CO^2 emissions calculation through Life Cycle Assessment is complex and costly.
- Packaging machines recovery: machines are durable goods that can have several lives. Packaging distributor, in its quality of machine distributor, can propose a machine recovery service. Machines could be retrofitted and sold as used machines or be used for spare parts or supply specifics recovery and recycling channels.

Other services could be added along the way, such as packaging reverse logistic.

An option to get stakeholders’ interest for a packaging distributor is to promote not only standalone sustainable products and services but also to mix them in a solution.

The solution offer: by combining products and services together and integrating life-cycle thinking, an enhanced global solution offer can be proposed in a “peace of mind” approach. In such case, customers would fully rely on packaging distributor to supply a turnkey sustainable solution.

[66] Common allegation about waste decrease quantity and truck traffic reduction
[67] http://reduction.ecoemballages.fr/catalogue/

Today, in its commercial activity with large FMCG and retail organizations, packaging distributor mainly interacts with packaging purchasers, sometimes packaging users. But it does not have contact to upper level where the true players of change are. To promote a solution based approach, packaging distributor needs to address all the stakeholders with a holistic approach and adjusting the pitch to the audience:

1- Sustainable director / top management: for strategic sustainability discussions
2- Middle management (Purchasing and Sustainability): for tactical approach in selection process
3- Purchaser: operational negotiations about products

The global sustainable solution cannot be chosen without involvement and approval of customers' sustainability managers. The sales cycle can be quite long and involve many loops for specification definitions and price negotiation.

As previously seen (3.3, Re-duce), the most sustainable packaging is the one that does not exist. Although it is not possible in the current status quo, packaging distributor could contribute to giving the customer the feeling that packaging never existed. This ultimate solution would totally relieve customers from packaging burden through an offer of a "packaging-as-a-service" solution (PAAS). In such model, packaging distributor would recover packaging in the same quantity as what was delivered (Porter & Heppelmann, 2014). This can be achieved by relying on re-usable packaging or by removing used packaging or packaging waste. A reverse logistic scheme in coordination with various actors (waste management and supply chain) must be set-up to collect empty packaging after use. This solution has to be thoroughly studied, relevant KPIs accurately defined and offer precisely priced in order to ensure profitability while contributing to an enhanced customer experience.

This "green" value proposition should include all the scope of sustainability products, services and solutions in order to remain the one-stop-shop distributor for the customers. Nevertheless, it should entirely be embedded in the global offer, together with traditional range of products – even "unsustainable" ones. There should be the possibility to be presented separately in a dedicated brochure, catalogue or webpage. But it can as well be presented together with other products and services but with a clear identification, with a specific logo for example.

6.3 Sustainable logistic packaging: the needed competences

The logistical challenge induced by circular economy could only be tackled through a global approach. Being recognized as a preferred interlocutor able to deliver this global offer implies to be and stay informed, grow knowledge and develop expertise in the field of sustainability.

Packaging manufacturers as well as FMCG and retail have developed competence around sustainability, circular economy and recycling. Packaging distributor is lagging behind and has to close the gap to sustainability expertise. Even if this sustainability has not truly made its way to secondary/tertiary packaging purchasers within FMCG and retail, it is just a matter of time. Today, basic sustainability aspects are included into packaging bidding specifications (Bigot, 2018). One day will come when this topic will also be tackled during negotiation as a key decision-making driver. Additionally, "green" packaging is a complex matter where there are no certainties (what is true now can be false tomorrow and vice-versa) and many counter-intuitive situation (e.g bio-plastics also have a negative environmental

impact compared to oil based plastics because of chemicals used in agriculture to grow bio-plastic source (Remy, 2014)), packaging distributor needs to start building this competence now. It will be too late to start when customers will challenge this subject.

The needed competences to be developed by key resources would be:

- Packaging materials life cycle and associated GHG emissions (production, transport, usage and end of life)
- Recycling constraints and best recovery usage
- Recycled product benefits compared to virgin products
- Legal framework

These competences can be obtained either by training of internal resources or by recruiting outside specific profiles. Building competence would allow starting customers' relationship based on sustainability topic through key activities like meeting with suppliers' sustainability directors and managers, attend international conferences or contribute to specific projects and working groups. This will give packaging distributor exposure and grow awareness about market expectations and trends. Having people trained and sensitive to the sustainability concept is necessary to speak, advocate and convince customers or prospects. Such experts could support key-account salesmen at their customers when the need arises.

Based on internal competence, identification of key partners could allow defining the suppliers portfolio based on sustainability criteria such as environmental and sustainability certifications, adhesion to UN programs such as Global Compact or Sustainable Development Goals (SDGs). Together with identified key partners, packaging distributor would build the precise value proposition through products and service selection process.

Building internal competence on box optimization can be achieved through packaging engineers trained in palletization plans matching all constraints and regulations while delivering cost-efficient solutions.

This strategical approach should support the inception of a competitive advantage and contribute to change paradigm on sustainable logistic packaging. Given the complexity and constant evolution of this topic, mastering this approach and offering an adequate value proposition could become a true competitive advantage that customer would value and that would be difficult to bridge for competition. The keeping the edge implies to constantly and pro-actively rework the value proposition by associating innovative product and services.

6.4 Sustainable logistic packaging: the needed innovation

Regarding incremental innovation, it is necessary to strengthen the product, service and solution offer, bring value to the customer and eventually include some differentiation from competition. But it would not characterize a competitive advantage. It would anyhow be useful in the short term as it will optimize and streamline the model. It will as well contribute to an increased awareness of packaging distributor sustainability offer. But it will at one point in time unavoidably reach an asymptote and bring little or

even no further benefit. Then, truly breakthrough innovative solutions resulting from a life-cycle holistic thinking should take over to accelerate the pace of conversion.

Doing business as usual is no longer an option in order to gain or maintain a leadership position. Innovation is the accelerator that any organization needs in order to differentiate from competition and gain interest from the market. But innovation occurs everywhere and screening the market together with the support of packaging manufacturers is mandatory; it may deem necessary to stay informed through an efficient tech watch. In the field of tech watch, Internet of things and RFID are to be monitored as they allow connectivity, dialogue and geo-localization for indoor and outdoor applications.

The physical internet project shed light upon a closed loop and connected system for logistic packaging. Becoming durable and re-usable, logistic packaging cost would rise. It would therefore be considered more as an asset investment (to be purchased or rented) than a disposable item. This automatically raises the question of ownership. Such re-usable logistical packaging would change the current pattern of purchase and dispose. It could either stays property of manufacturer, or purchased by packaging user (industry, retail or logistic) or this service would be contracted to pooling specialist (like pallet or foldable boxes today[68]. Packaging distribution runs the risk to be excluded from some segments of the market and lose part of its business if not adapting to a new paradigm. Clearly, with emergence of connected objects, distribution runs the risk to be disintermediated by manufacturers (Porter & Heppelmann, 2014). Even if PI project does not materialize fully, it is echoing the trend towards more reusable packaging moving in a closed loop allowing repair and recycling. It started with pallets. It is now expanding to roll-cage trolleys and foldable boxes for fruits and vegetables. It will surely expand futher.

6.5 Conclusion

Disposable packaging will not disappear. But it will surely reduce impacted by virgin resource scarcity and price volatility and development of re-usable packaging. As massive users of logistic packaging, FMCG and retail are monitoring market trends. They will also experiment new schemes, pushed by e-commerce growth changing logistics and packaging and by GHG emissions pricing. Packaging distributor should include these trends in its strategic thinking to be able to counteract the upcoming adverse effects and contribute to a more sustainable logistic packaging through an appropriate offer of alternative products and innovative services and solutions.

[68] See Chep; https://www.chep.com/fr/en/consumer-goods

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8 Appendixes

8.1 Market Size

Market Size of Logistic Packaging for FMCG according to Smithers Pira[69]

2016								
	World	Packed CG	FMCG	Food	Non Food	Europe	France	France FMCG
Pallets	37.5	29.5	17.9	13.9	4.0	12.3	1.7	**0.8**
Strapping and ancillary	12.4	-	-	-	-	4.1	-	**-**
Stretch Wrap	7.0	5.5	3.4	2.6	0.8	2.3	0.3	**0.1**
Corrugated Boards	7.6	6.3	3.9	3.0	0.9	2.5	0.3	**0.2**
TOTAL	64.5	41.2	25.2	19.6	5.6	21.2	2.2	**1.1**
in % of World Total		63.9%	39.1%	30.4%	8.7%	32.9%	3.5%	**1.7%**

2022								
	World	CG	FMCG	Food	non food	Europe	France	France FMCG
Pallets	44.47	33.26	20.44	15.26	5.18	13.48	2.61	**1.20**
Strapping and ancillary	14.28	-	-	-	-	4.47	-	**-**
Stretch Wrap	9.40	7.05	4.34	3.25	1.08	2.85	0.34	**0.16**
Corrugated Boards	9.52	7.57	4.68	3.51	1.18	2.88	0.34	**0.17**
TOTAL	77.67	47.89	29.46	22.02	7.44	23.67	3.30	**1.53**
in % of World Total		61.7%	37.9%	28.3%	9.6%	30.5%	4.2%	**2.0%**

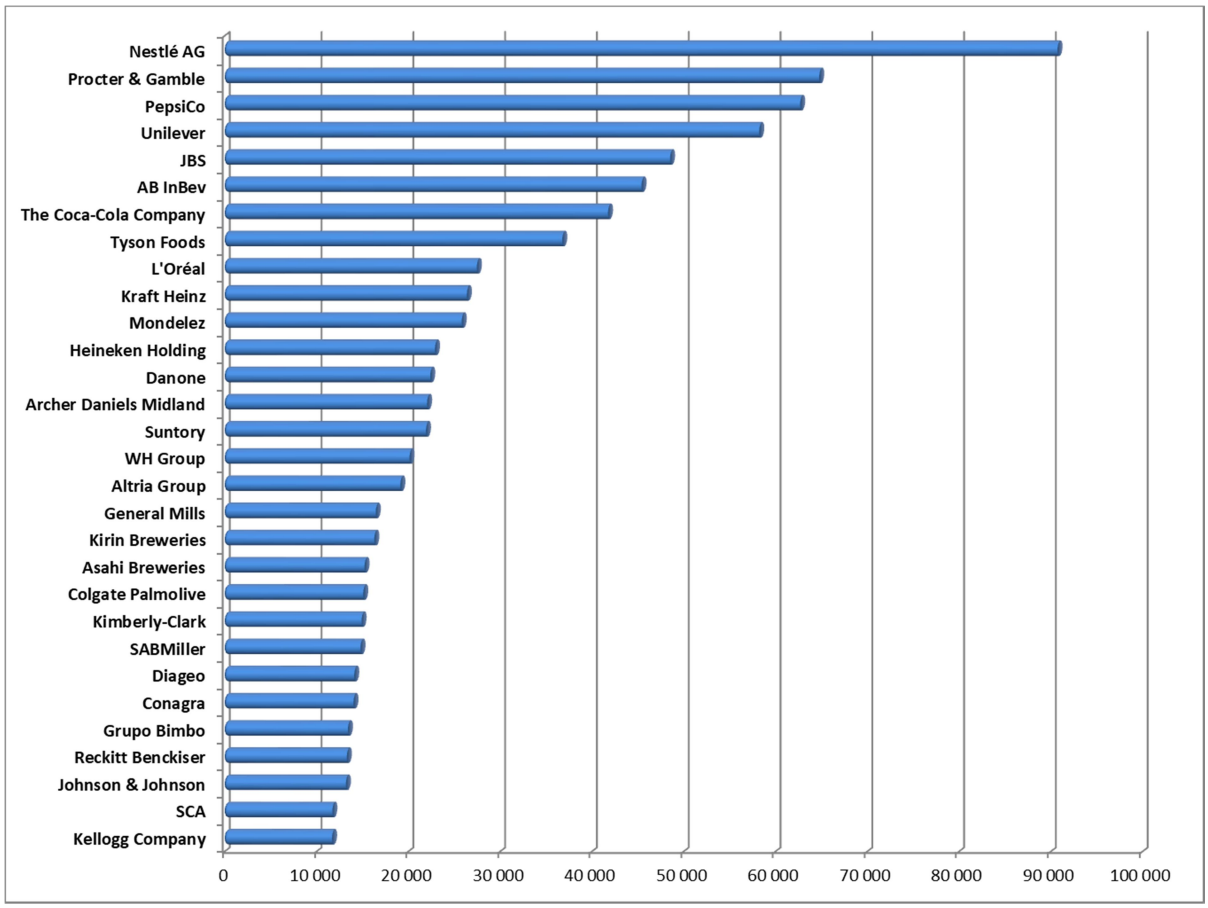
CG = consumer goods

[69] « the future of protective and transit packaging to 2022" by Robert C Brothers / Smithers-Pira 2017 pages 93

8.2 Top 30 FMCG companies

Ranking of top worldwide FMCG companies by turn-over[70]

(Excluding tobacco companies as they do not follow FMCG model in France)



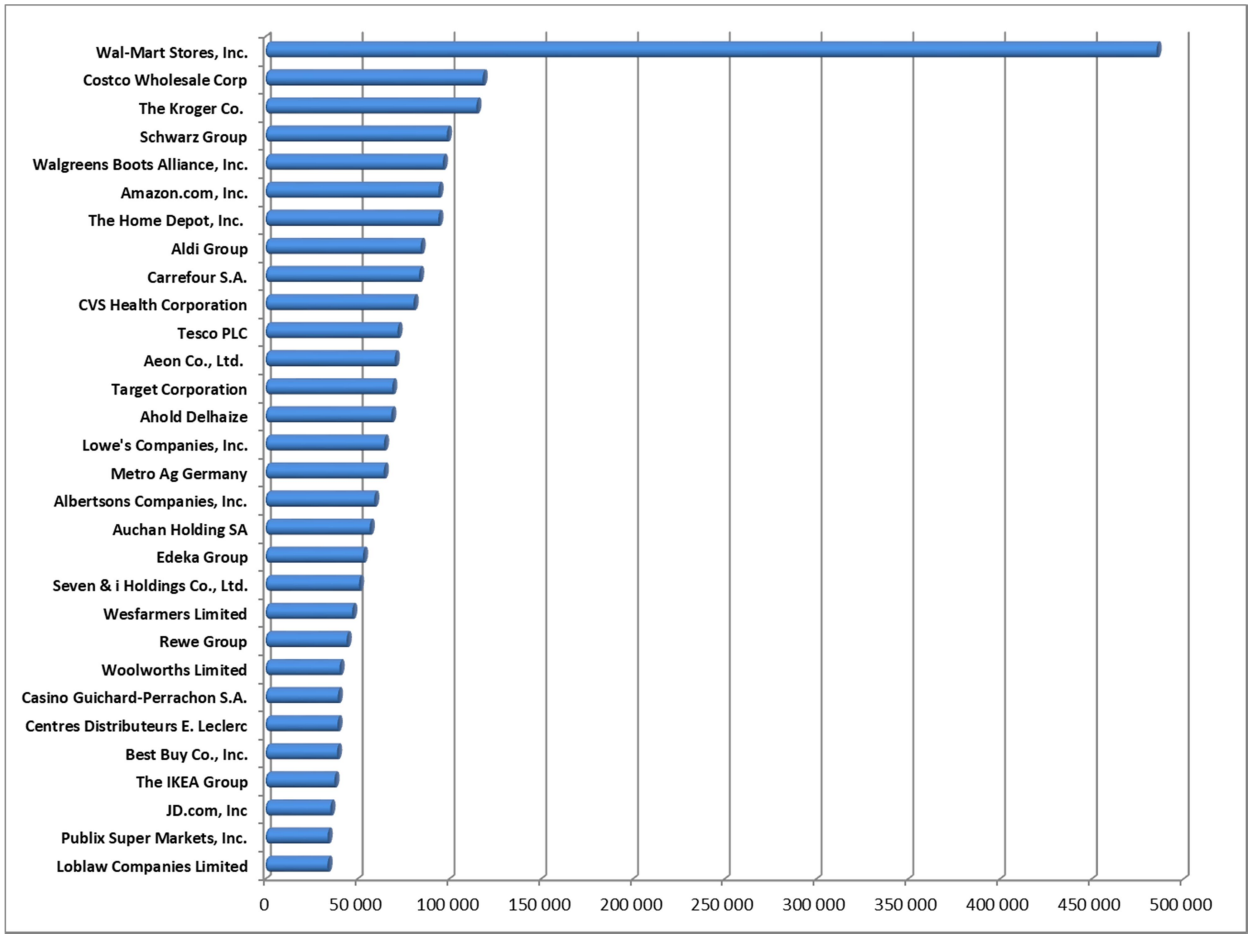
Top worldwide brands per FMCG company:

#1 **Nestlé**: Nescafé, Nesquick, Cheerios, Maggi, Buitoni, Herta for food - Perrier, Contrex for waters
#2 **Procter & Gamble**: Head & Shoulders, Pampers, Gillette for personal care – Ariel, Dash and Swiffer for home care
#4 **Unilever**: Alsa, Amora or Knorr for food - Dove, Signal, Rexona for Personal care – Cif, Omo, Persil, Domestos for home care
#9 **L'Oréal**: L'Oréal, Garnier, Maybelline
#10 **Kraft-Heinz**: Heinz ketchup and dressings, Benedicta
#11 **Mondelez**: LU, Milka, Cadbury …
#13 **Danone**: Activia, Actimel, Danette, Gervais for dairy and Evian, Badoit, Volvic for waters
#18: **General Mills**: Yoplait, Häagen-Dasz, Green Giant, Old el Paso, Cheerios

[70] lebensmittelzeitung.net by Statista, 09/2017

8.3 Top 30 Retail Distribution companies

Ranking of top worldwide Retail companies by turn-over[71]



[71] Global Resource of Retailing 2018, Deloitte

8.4 Pallets

Pallet has become the standard for logistics in the 1970's when growth of consumption, need for transportation between production sites and purchasing locations. Over almost 50 years, manufacturers efficiently optimized production, use and disposal of pallets.

Although associated to Packaging, pallet is a bit hybrid because pallet manufacturer are not into packaging industry but limber industry.

Pallets can be made of wood, metal or plastic.

In France, wooden pallets (new & refurbished) represent 95% of the market – the reminder being split between Metal and Plastic. [72]

- Comparative table of pallets (dimension 1200x800)[73]

	Wood	Wood refurbished	Metal	Plastic
# of use	28	25		
Weight in kg	26	26	36	13-18
Price (HT) / pallet	From 18€ to 25€	15€	From 200€ to 230€	From 40€ to 90€

Wooden pallet industry has long ago organized to meet productivity requirements to fulfill price attractiveness as it served very competitive transportation sector. Thus, all this structuration supports pallet industry in meeting the current sustainability criteria:

- Sustainable sourcing
- Re-use / repair
- Recycle

Pallet industry is centered around 3 major actors, all contributing to making this industry well organized

- Pallet manufacturers
- Pallet rental companies
- Pallet refurbishment companies

In terms of sourcing, pallet industry relies on mainly two options, both being sustainable. It can be either wood coming from sustainably managed forest (FSC / PEFC) or it can be wood coming from tree-thinning (that would have been either discarded or used as wood fuel).

Regarding re-use and repair, the industry organized itself and many companies are disseminated on the territory.

[72] Site internet palettes
[73] http://rotomshop.fr/palettes.html
https://stockage.ooreka.fr/comprendre/palette-stockage

Another lever used by pallet industry is to "relocate" pallets in order to avoid unnecessary transportation and thus contributing to fewer GHG emissions. This system is working at European level as all pallets standard have been harmonized across the EU[74]. Pallets are managed in pool and are re-addressed by freight forwarding companies to customers from the closest storage location. It is an evolution of the returnable packaging. The results are illustrated by the relatively low distance covered by pallets: 41% of new pallets and 55% of used pallets are sold and 59% of second-hand pallets are recovered within 100km[75].

Pallet industry is proud to announce a negative carbon footprint[76]. This is mainly the result of wood being a carbon sequestration product but also of an industry having organized itself around the basics of sustainability: re-use / repair / recycle. All along the supply chain, pallets a sorted by industrials, retailers and freight forwarders in order to keep in use good quality pallets. Broken and damaged pallets are then oriented to refurbishment companies. These companies have collected 106 million pallets in France in 2015 and have put pack on the market 94 million, the remaining 12 million have be addressed to recycling/recovery[77]. The cost and environmental impact of pallet repair can be considered negligible with more than 200 companies covering the national territory: this means an average of 2 per department.

Humidity included in wooden pallets, which can result from external storage for example, can increase by 9kg its normal weight of 26kg, thus increasing gross cargo weight and influencing negatively fuel consumption during transportation. Knowing that a trailer truck can contain up to 33 euro pallets, this in an increase of 300kg of total cargo (roughly half a pallet, i.e. +1.5%) but could result in an increase of more than 5 tons on a full truck of pallets (case for pallet recovery). This aspect does not concern metal or plastic pallets which are insensitive to this phenomenon.

Regarding end of life (because pallets cannot be repaired and re-used indefinitely, it is estimated that pallets last around 8 years with a frequency of 3.5 rotations per year[78]), Waste management or pallet refurbishment companies are re-addressing old pallets to specific transformation companies. Decommissioned pallets are grinded into wood chips used for industrial heating (80%) and for construction (20% with wooden walls and timber frames & structures) s well as composting for agriculture. This resource is estimated at 0.8 million tons per year[79] is substituting either construction materials or fossil energy, big providers of waste and CO^2 emissions[80].

This is a good example of sustainability being cost efficient that could be a source of inspiration for other packaging industries.

[74] http://www.palettes-europe.com/palette_epal-eur.html
[75] Etude Structurelle ; palettes, caisses-palettes, emballages industriels, emballages légers », données 2015, Institut d'informations et de Conjonctures Professionnelles. 23/5/2017. Page 26.
[76] « la palette bois enfonce le clou », Sypal (Syndicat des fabricants de palettes), page 11
[77] Etude Structurelle ; palettes, caisses-palettes, emballages industriels, emballages légers », données 2015, Institut d'informations et de Conjonctures Professionnelles. 23/5/2017. Page 20.
[78] « la palette bois enfonce le clou », Sypal (Syndicat des fabricants de palettes), page 8
[79] Sortie de Statut de Déchet Broyats de d'Emballages en bois, Eco-bois, JP.Tachet & L. de Reboul, 03/2015
[80] http://www.sita.fr/bois-et-palettes/

Plastic pallets are also developing (heavy-duty) made of recycled plastics: Intermarché purchased end of 2016 260,000 plastic (HDPE = high density polyethylene) pallets for their downstream supply-chain (warehouse to store): this evolution was made possible thanks to cost savings compared to wooden pallets resulting from lower breakage rate despite intensive use (50 rotations per year), lower weight (12kg vs 26kg, positive for reverse logistic), optimized transported cargo with higher useful load and pallet which is 70% recycled plastic caps[81] and 100% recyclable: another step towards sustainable transit packaging. [82] This solution also echoes to the growing need of distribution automation[83] : with dimensional and weight stability, pallets could integrate more easily automated processes comprising conveyor belts, palletizers and racks.

Metal pallets are more present, especially in retail, under the form of trolleys often used to deliver small quantities in small retail shops.

[81] Emballagesmagazine.com, 23/5/2016
[82] http://www.strategieslogistique.com/Intermarche-s-equipe-de-250-000,6400
[83] « the future of protective and transit packaging to 2022" by Robert C Brothers / Smithers-Pira 2017 pages 12

8.5 Corrugated

Norm EU 643 List of European standard types waste paper

Group 1 - Ordinary grades

1.01 - Mixed paper and board, unsorted, but unusable materials removed
A mixture of various grades of paper and board, without restriction on short fibre content.

1.02 - Mixed papers and board (sorted)
A mixture of various qualities of paper and board, containing a maximum of 40% of newspapers and magazines.

1.03 - Grey board
Printed and unprinted white lined and unlined grey board or mixed board, free from corrugated material.

1.04 - Supermarket corrugated paper and board
Used paper and board packaging, containing a minimum of 70% of corrugated board, the rest being solid board and wrapping papers.

1.05 - Old corrugated containers
Used boxes and sheets of corrugated board of various qualities.

8.6 Plastics

Plastics are one of the most complex items when it comes to sourcing, using, sorting and recycling.

There are two mains categories of plastics: thermoplastics (listed below) which are all recyclable and thermosetting which are not recyclable as the transformation experienced is not reversible[84].

First, there are 7 different thermoplastics as shown in table below[85]:

Logo	Abbreviation & Name	Prime usage	Recycled usage	Logistic Packaging application
	PET / PETE	Water bottles Shampoo bottles	Water bottles	Strapping
	HDPE	Milk bottles Shampoo bottles	Chemical bottles, Boxes Waste bags	Boxes Pallets
	V / PVC	Food boxes	Outdoor furniture	Corner protection
	LDPE Low Density Poly Ethylene	Waste bags Plastic bags	Mailers Waste bags	Stretch & shrink films
	PP Polypropylene	Food boxes Plastic tableware	Brooms & brushes Trays Ice-scrapers	Strapping
	PS Polystyrene	Food boxes Plastic tableware	Hangers Flower pots	N/A
	Others Mostly Nylon and Acrylic	-	-	N/A

The fact that these family numbers are represented into the Möbius circle means that they are all recyclable.

[84] https://ecoinfo.cnrs.fr/2016/05/10/recyclage-des-plastiques/
[85] https://lemballageecologique.com/2011/06/30/les-symboles-du-recyclage-sur-les-emballages-plastiques/
https://envi2bio.com/2013/09/15/tri-selectif-recyclage/#jp-carousel-7164
http://instiks.com/pin/2796/

Film bales specification for a qualitative recycling feedstock (Plastic Recyclers Europe – November 2017)

RecyClass™
PLASTICS RECYCLERS EUROPE

PE Transparent Natural Flexible film

	YES Full compatibility Materials that passed the testing protocols with no negative impact OR materials that have not been tested (yet), but are known to be acceptable in PE recycling	CONDITIONAL Limited compatibility Materials that passed the testing protocols if certain conditions are met OR materials that have not been tested (yet), but pose a low risk of interfering with PE recycling	NO Low compatibility Materials that failed the testing protocols OR materials that have not been tested (yet), but pose a high risk of interfering with PE recycling
Polymer	PE-LD; PE-LLD; PE-HD	multilayer PP/PE	any other polymer
Colours	unpigmented; transparent; white	light colours; translucent colours	dark colours
Barrier	barrier in the polymer matrix	barrier layer EVOH (in polyolefinic combination film); metalized layers	barrier layer PVC; PA, PVDC; any other barrier layer foaming agents used as expandant chemical agents; aluminium
Additives			additives concentration ≥ 0.97 g/cm³
Labels	PE label	Paper label	metalized labels; any other
Adhesives	water soluble (less than 60°C)		
Inks	non toxic - follow EUPIA Guidelines	inks that bleed	toxic or hazardous inks
Direct Printing	laser marked; production or expiry date	printing covering < 50%	printing covering ≥ 50%

Last updated November 2017

RecyClass™
PLASTICS RECYCLERS EUROPE

PE Coloured Flexible film

	YES Full compatibility Materials that passed the testing protocols with no negative impact OR materials that have not been tested (yet), but are known to be acceptable in PE recycling	CONDITIONAL Limited compatibility Materials that passed the testing protocols if certain conditions are met OR materials that have not been tested (yet), but pose a low risk of interfering with PE recycling	NO Low compatibility Materials that failed the testing protocols OR materials that have not been tested (yet), but pose a high risk of interfering with PE recycling
Polymer	PE-LD; PE-LLD; PE-HD	multilayer PP/PE	any other polymer
Colours	light colours; translucent colours	dark colours	
Barrier	barrier in the polymer matrix	barrier layer EVOH (in polyolefinic combination film); metalized layers	barrier layer PVC; PA, PVDC; any other barrier layer foaming agents used as expandant chemical agents; aluminium
Additives			additives concentration ≥ 0.97 g/cm³
Labels	PE label	Paper label	metalized labels; any other
Adhesives	water soluble (less than 60°C)		
Inks	non toxic - follow EUPIA Guidelines	inks that bleed	toxic or hazardous inks
Direct Printing	laser marked; production or expiry date; printing covering < 50%	printing covering ≥ 50%	

Last updated November 2017

8.7 Main NGOs acting in Sustainability

Sustainability:

CDP: Carbon Disclosure Project: https://www.cdp.net/fr

GRI: Global Reporting Initiative: https://www.globalreporting.org/Pages/default.aspx

SBTI: Science Based Target Initiative: http://sciencebasedtargets.org/

Ellen McArthur Foundation: https://www.ellenmacarthurfoundation.org/

Greenpeace: https://www.greenpeace.fr/

WWF (World Wide Fund for Nature): https://www.wwf.fr/

Business:

World Economic Forum: https://www.weforum.org/

The Consumer Goods Forum: https://www.theconsumergoodsforum.com/

Packaging:

Conseil National de l'Emballage: https://conseil-emballage.org/

FNbois (pallets): http://www.fnbois.com/palettes-palox-et-caisses-palettes/

Waste Recovery and Recycling:

FEDEREC: Fédération Nationales des entreprises du Recyclage: http://federec.com/

Revipac: paper and board packaging recycling: http://www.revipac.com/

Governmental

ADEME: Agence de l'Environnement et de la Maîtrise de l'Énergie : http://www.ademe.fr/

Ministère de la Transition Écologique et Solidaire : https://www.ecologique-solidaire.gouv.fr/

8.8 Interviewed people

Packaging Producers:

- Manuli Stretch: flexible film producer
    - Massimo Moroni, sales director

FMCG industrial

- Yoplait – General Mills
    - Florian Trohay, Europe Australia CSR and Sustainability Manager
    - Daniel Lucot, Packaging Expert
- Danone
    - Marie-Pierre Bousquet, Nature 2020 Finance
    - Feliks Bezati, PhD, Circular Economy Manager | Resources Efficiency
- Coca-Cola
    - Emmanuelle Badouix, former Directeur Associé Recyclage
- Continental Foods
    - Sandrine Bigot, Purchaser (and former packaging purchaser at General Mills

Retail:

- Carrefour
    - Bertrand Swiderski: Group Sustainability Director

Waste Management:

- Paprec
    - Philippe Groulez, Sales Director

Stakeholders:

- Eco-Act
    - Nicolas Malpièce, Senior Consultant

Packaging Distributor

- Antalis
    - Steffen Rapp, International Key Account Director
    - Jean-François Singier, Western Europe Supply Chain Director

8.9 Regulatory Landscape

Sustainability is governed by laws, directives, norms and rules in many countries which are, to a certain extent, transcription in national frame of upper level directives set-up by supra-governmental bodies such as EU or UN and this since quite a long time.

It all started at EEC level with the first directive 85/339/EEC dated June 27th, 1985 relative to "containers of liquids for human consumption" with a clear target stated in its Article 1 *"The purpose of this Directive is to provide for a series of measures relating to the production, marketing, use, recycling and refilling of containers of liquids for human consumption and to the disposal of used containers,* ***in order to reduce the impact of the latter on the environment and to encourage a reduction in the consumption of energy and raw materials*** *in this field"*.
This first directive can be considered as a cornerstone although it was limited to primary packaging. But the link between packaging as a whole and environmental impact (reduction of energy and raw material consumption) was made. It fostered member states to develop systems in order to exclude used "containers" from household waste through selective collect in order to "re-use" or "recycle" the recovered packaging. This directive could be considered as a cornerstone in the emergence of environmental actions.
This first attempt was followed by several national initiatives; influenced by the ecological sensitivity of certain member states, laws were more or less stringent, scope-wide and compelling.
After some national development, the need for a harmonized approach was considered necessary and directive 94/62/EC on "Packaging and Packaging Waste" was issued on December 20, 1994. This Directive was completed by decision 97/129/CE relative to material identification and by decision 2005/270/CE relative to Data basis as (article 12 from 94/62/EC) [86]
Main purposes of this directive are:

- Generalization of EPR (enlarged producer responsibility)
- Priority given to packaging waste prevention and recycling through precise guidelines in regards to packaging optimization, material content (hazardous materials) and end-of-life management.
- Replacement of initial directive 85/339/EEC (preamble)

All these directives have had a transcription into French regulatory framework, being laws (with corresponding legislative decrees) or Government ordinances, all texts being integrated into "Code de l'Environnement", a Master Document of more than 2500 pages, covering all rules that need to be followed, in whatever sector. Articles of "Code de la Consommation" regarding false environmental claims [87] need also to be considered in

The French laws and decrees on packaging environmental scope are 6:

[86] https://aida.ineris.fr/consultation_document/1035
[87] Code de la consommation, articles L121-1 to L0121-5

a- Decree n°92-377 & updates (corresponding to articles R.543-53 t R.543-65 of "Code de l'Environnement"): setting-up the basis of Producer Enlarged Responsibility (REP = Responsabilité Elargie du Producteur) which holds the actor (producer, importer …) providing the market with a packaged product should take responsibility for contributing to disposal of post-consumption packaging waste. This disposition led to creation of « Eco-emballage » and "Adelphe" in 1992 to which all companies are contributing to finance all necessary specific collection and sorting facilities (see calculation below).
b- Decree n°94-609 & updates (corresponding to articles R.543-66 to R.543-74 of "Code de l'Environnement"): this article is key as it imposes to all companies, generating or holding packaging waste, to recover it through various schemes outside of the primary packaging already covered by Decree n°92-377.
c- Decree n°96-1008 & updates are the follow-up of Decree n°92-377 defining prevention and recovery of households packaging waste through quantitative targets and set-up of selective waste collection.
d- Decree n°98-638 & updates focuses on eco-design/eco-conception and eco-manufacturing of packaging
e- Law n°2009-967 & updates – and specifically article 46[88]
f- Law n°2010-788 & updates – and specifically article 199[89]

This legal framework establishes a clear distinction between EPR for household waste and non EPR for retail and industrial waste: all packaging is covered but the final step to recovery is relying on different flows depending on waste collection - but managed by the same waste management companies in the end as they are covering the full scope of waste collection and sorting.

Out of 6 laws or decrees, 5 are concerning EPR and primary packaging.
If only 1 is concerning industrial & commercial waste (articles R.543-66 to R.543-74 of "Code de l'Environnement"), it structured a dedicated industry and defined processes and specifications regarding this source of recyclable materials.

The latest text issued relates to GHG emission calculation and declaration for legal entities (being private company, association of more than 500 employees or public bodies of more than 250 employees or territorial collectivity of more than 50,000 inhabitants) according to article 75 of law n°2010—788 of 12 July 2010 (loi Grenelle II) modified by ordonnance n°2015-1737 article 1 [90]dated 24th December 2015. This text imposes to eligible entities to perform the mandatory GHG emissions for scopes 1 and 2 every 4 years. Since 2016, they also have to declare GHG emissions for significant contributors of their scope 3. Failure to do so would result in a fine that cannot exceed 1500€.

88
https://www.legifrance.gouv.fr/affichTexteArticle.do?cidTexte=JORFTEXT000020949548&idArticle=JORFARTI000020949632&categorieLien=cid
89 https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000022470434&categorieLien=id
90 https://www.legifrance.gouv.fr/eli/ordonnance/2015/12/24/DEVR1523496R/jo/texte

In 2020, the "Circular Economy Package" adopted by the EU in April 2018 will be adapted to the French law[91]. Main objectives of this package are reduction of landfills (maximum of 10% of municipal waste by 2035) and increase packaging recycling rate up to 65% by 2025 and 70% by 2030. This target is broken-down by specific material according to the following table:

	By 2025	By 2030
All packaging	65%	70%
Plastic	50%	55%
Wood	25%	30%
Ferrous metals	70%	80%
Aluminium	50%	60%
Glass	70%	75%
Paper and cardboard	75%	85%

Source = EU circular economy package

All these laws and decrees also constitute a basis to levy taxes and contribution with a dual objective: Finance all necessary infrastructure needed and influence changes towards (more) sustainable solutions. In France, this is embodied by:

a) Eco-contribution (only linked to EPR) to finance all specific collect, sorting and recycling infrastructures
b) Carbon contribution (known as "Taxe Carbone" or "Contribution Climat Energie" to limit GHG emissions) to gear energy and transportation sectors towards more frugal solutions.

Evolution de la composante carbone de la TICPE en €/tCO2					
2017	**2018**	**2019**	**2020**	**2021**	**2022**
30,5	44,6	55	65,4	75,8	86,2

This is reflected into the 3 other taxes on electricity, gas and coal.

In addition to the above laws, EC enacted 6 norms [92] to ensure compliance of packaging to basic rules of sustainability:

[91] http://www.europarl.europa.eu/news/en/headlines/society/20170120STO59356/the-circular-economy-package-new-eu-targets-for-recycling
[92] https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/packaging_en

1- EN13427: Requirements for the use of European Standards in the field of packaging and packaging waste
2- EN13428: Prevention by Source reduction
3- EN13429: Reuse
4- EN13430: Requirements for packaging recoverable by material recycling
5- EN13431: Requirements for packaging recoverable in the form of energy recovery
6- EN13432: Requirements for packaging recoverable through composting and biodegradation

These norms have been localized in EU countries by their respective Normative Organizations (AFNOR in France).

Tertiary Packaging is also largely influenced by EU directive 2014/47/UE relating to technical roadside inspection. Article 13 focuses on "inspection of cargo securing". As seen before, the finality of tertiary packaging is to ensure stability and protection of unit loads. But this directive does not give detailed specification, relying on existing norms that are mentioned in Appendix III. Among the 11 applicable norms listed in the appendix, Norm EUMOS 40509[93] from 2012 aiming at securing loads and pallets in the supply chain is of interest as it defines the tolerances of deformation of a pallet during transportation. This deformation is linked to cargo weight (heavy cargo will have the tendency to move more) and tertiary packaging (in quality and quantity). As an example, tolerated permanent deviation of a load cannot exceed horizontally 5% of its total height; temporary deformation (oscillation) cannot exceed 10% of its total height; for multi-layers pallets (which is the case for most of FMCG goods) sliding of one layer versus another cannot exceed 2% of total pallet height. This norm also defines tests that can be conducted to ensure load stability.

[93] http://eumos.eu/quality-standards/

8.10 ISO Normative Landscape

ISO (International Organization for Standardization):

Several aspects of Sustainability are covered by ISO norms in order to help companies assessing, implementing and measuring Sustainability in its various aspects.

ISO14001 for environmental management system (monitoring and improvement of all company processes that could have an impact on the environment, such as Waste Management, Production, Transportation …), including norms ISO14040 and 14044 on Life Cycle Assessment.

ISO18601 and following for Packaging and the environment: Optimization of the packaging system – which is relating to European Norms cited above (EN13427 and following).

ISO26000 for Corporate Social Responsibility (CSR) management system (beyond environment and sustainability, business conduct in regards to Social and Ethics having a positive impact on society)

ISO50001 for energy management system (energy being the focus point of GHG emissions)

Of course, certification of conformity can be delivered by an accredited external auditor to testify about application of and compliance to these rules.

Industrial Companies using these certifications [94] to ensure compliance of their production processes to their environmental commitments and obligations.

https://www.iso.org/obp/ui/fr/#iso:std:iso:18602:ed-1:v1:en:fn:1

https://www.iso.org/fr/news/ref2287.html

[94] « Les pratiques environnementales des entreprises", Sylvie Dumartin, Insee Premières n°1673 – Nov. 2017

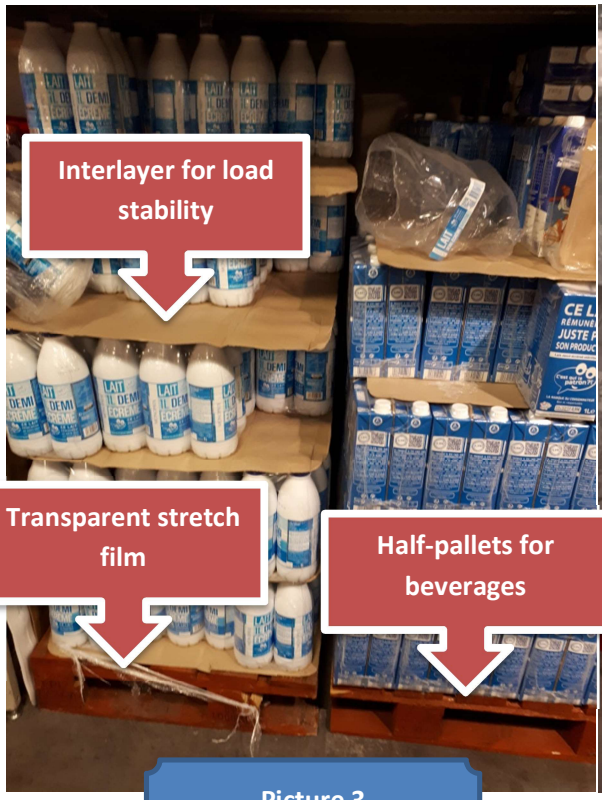
8.11 Illustration photography / pictures

In-store

Pallets

Picture 1

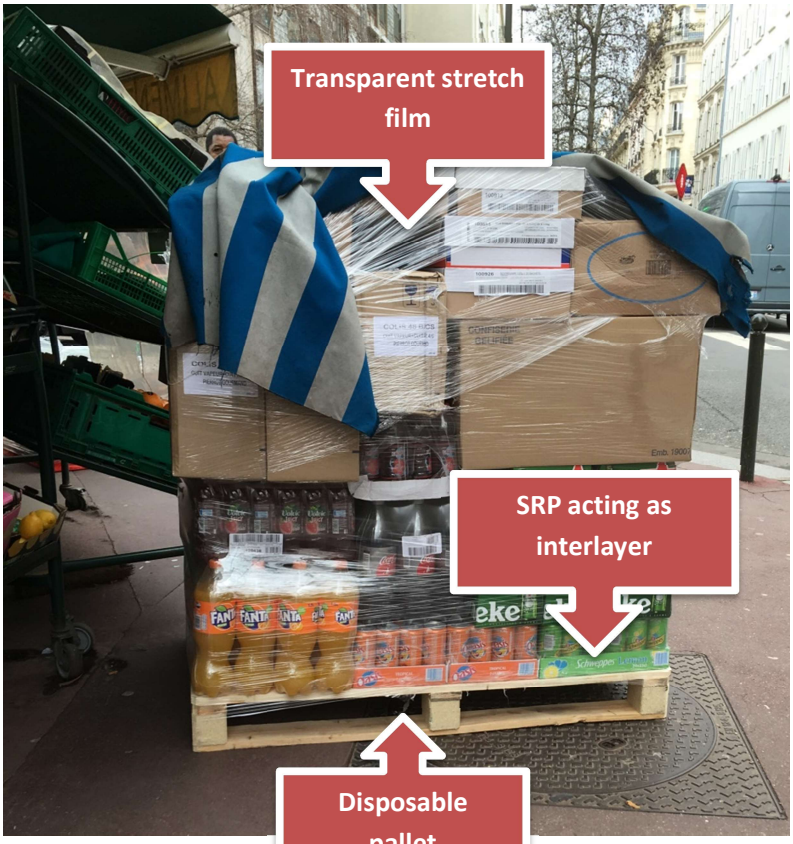
Picture 2



Picture 3

Picture 4

Picture 5


Transparent stretch film
SRP acting as interlayer
Disposable pallet

Picture 6

Picture 7

Picture 8

Picture 9

Picture 10

Picture 11

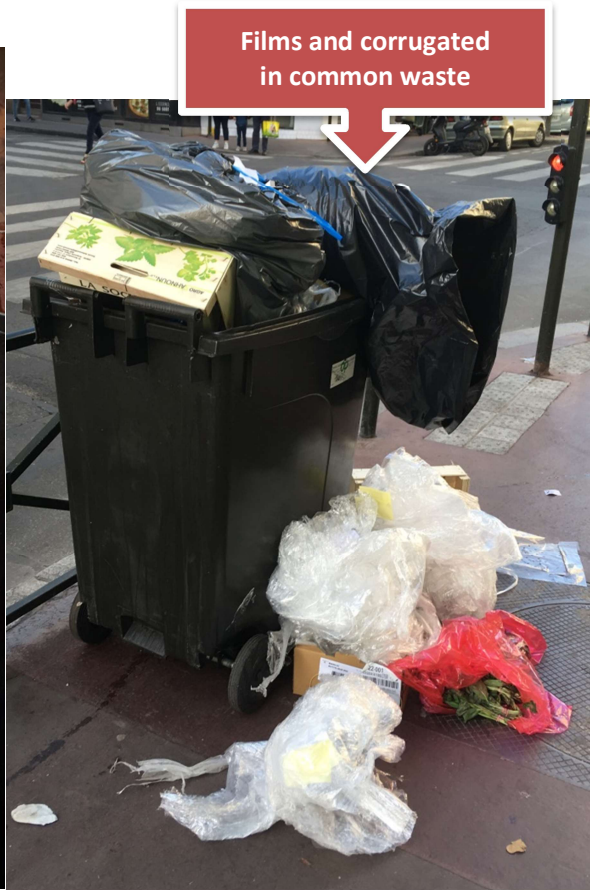
Corrugated bale ready for collection

Picture 12

ready for collection : re-usable packaging and waste

Picture 13

Picture 14



Picture 15

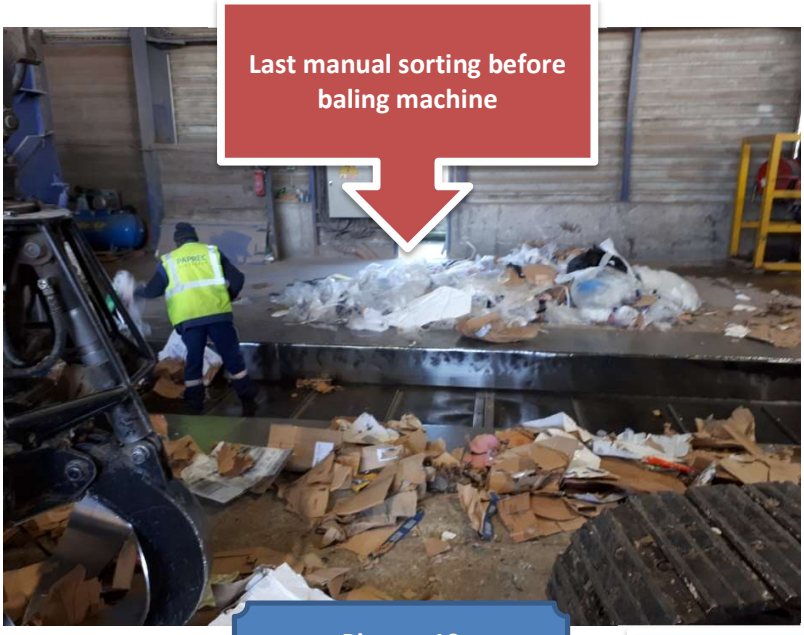
Truck from retail plateform :
Bales of corrugated and films

Picture 16

Bulk corrugated
out of compactors

Picture 17

Picture 18

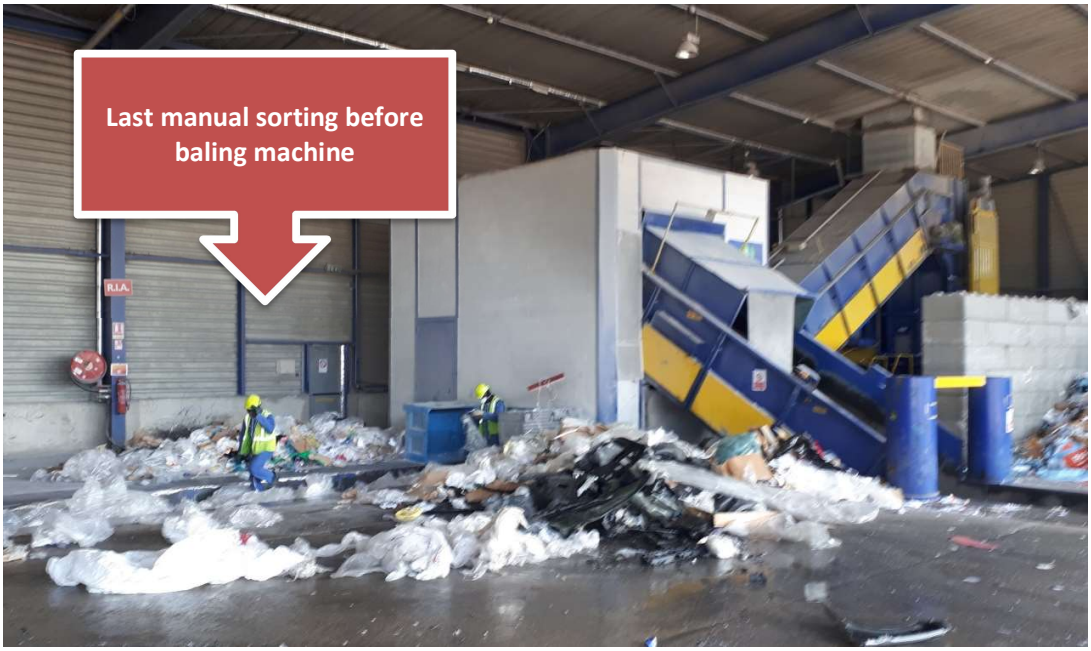


Picture 19

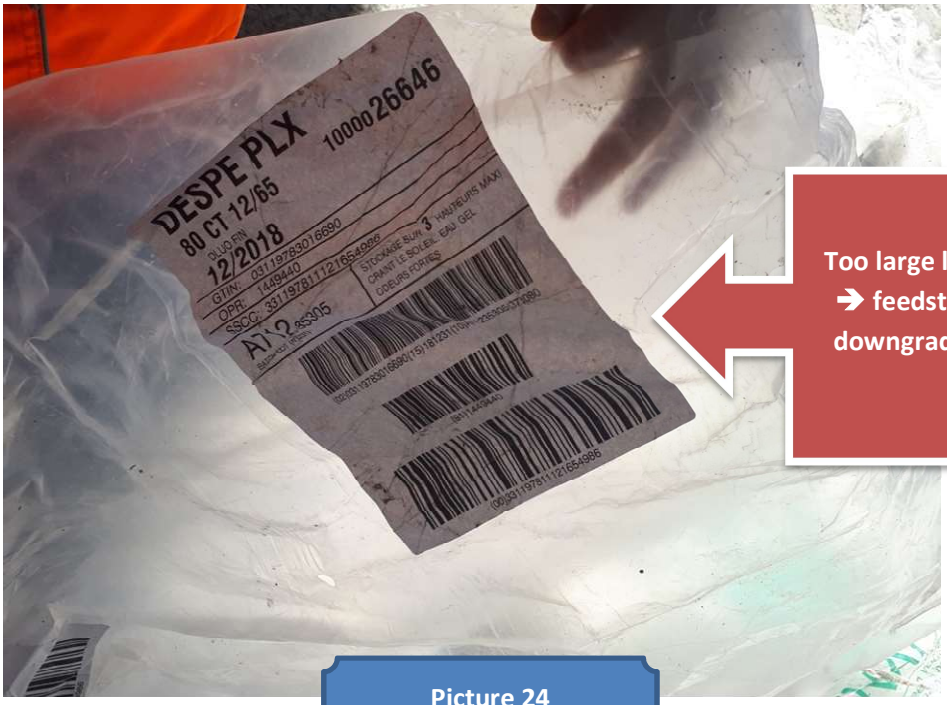
Picture 20

Picture 21

Picture 22



Picture 23



Picture 24

Light film bales out of baling machine

Picture 25

Picture 26

Picture 27

Towards Greater Sustainable Logistic Packaging for FMCGs:

Mission Impossible?

Pierre-Michel Besson

Executive SMIB Spring 2016-2017

Essec Executive Education

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TABLE OF CONTENT

1 Introduction

The aim of this study is to explore if and how, in France, logistic packaging[1] for Fast Moving Consumer Goods[2] (FMCG) could be (more) sustainable (than it is today).

The question of increased sustainability has become key nowadays considering that global conditions are evolving rapidly and sometimes drastically. Legislative and regulatory framework are becoming more and more stringent, driven by strong political willingness and circular economy principles applied into European and national laws, raw material & commodities shortages and price volatility are influenced by oil price and geopolitical tensions, fiscal burden is becoming heavier in order to incentivize gradual shift towards greener economy and business opportunities dry up. Recent China ban on waste import illustrates, if need be, the rapidity and importance of unexpected external factors heavily impacting a whole industry (i.e. recycled material supply).

Among the top 30 FMCG companies worldwide[3][4], two are of French origin (L'Oréal and Danone), eight are from other European countries and many companies amongst the top 30s have a strong French industrial footprint. France is also well represented in the worldwide top 30s distribution sector including retailers like Carrefour, Auchan, Casino, Leclerc.
Since the regulatory and taxation landscape as well as retail practices and waste management services are rather different from one European country to another, this study focusses on France in order to be relevant regarding analysis and recommendations. However, approach and methodology could be applied to assess any other country, by varying the various components of the equation, including aspects such as waste collection, recycling capabilities and infrastructures and amounts of contributions and taxes levied.

Logistic packaging is used to aggregate consumer product selling units into a convenient unit load for supply chain efficiency. It is generally disposed after use. The consumer goods industry and mass retail complex supply chain schemes generally comprise several steps between production sites and stores. They generate a significant amount of break of loads and re-packing operations resulting into packaging waste, which is not always recovered for recycling, depending on waste management programs in place. Logistic packaging is mainly composed of wood, corrugated and plastics, using both virgin and recycled materials but not always from sustainable source.
FMCG is an important producer of Green House Gas (GHG) emissions in the entire goods life cycle[5] (estimated to 60% of worldwide emissions - (Berruti, Giorgi, & Morgan, 2017). According to Thierry Gaillard, Ania[6] VP in charge of sustainability "the Food & Beverage industry contributes up to a third of the global CO^2 emissions from raw material production up to final consumption". At the same time, due to its large consumer exposition, the Food & Beverage and retail industries have developed a strong

[1] Also referred to as secondary and tertiary packaging or transit packaging
[2] food and non-food non-durable products with low nominal value and high repurchase frequency
[3] See appendix 8.2
[4] See appendix 8.2
[5] Life cycle (or cradle to grave) = environmental impacts of a product all along its useful life: from its raw material production to its end-of-life disposal, passing through production, transportation distribution and consumption steps.
[6] Ania = Association Nationale des Industries Alimentaires

concern, specific policies and efficient communication with regards to sustainability practices and processes.

A restrictive definition if sustainability[7] applicable to logistical packaging can be retained:
"Sustainability is the cleanest way to procure, produce, deliver and ensure disposability of one's product" (PwC).

For the sake of clarity, this study will focus on environmental aspects. Governance, Social & Human Rights aspects of Social Responsibility (such as Labor Practices, Business Practices …) will not be covered by this thesis due to its scope.

Many stakeholders, including NGOs and NPOs, are influencing this stronger focus by playing a role of gatekeeper and whistleblower when countries and industries are drifting from the agreed 2°C trajectory. Not only they alert, but they also can play an active role in closing the gap of GHG emissions (Berruti, Giorgi, & Morgan, 2017).
Professional associations and waste management companies actively contribute to spreading best practices and prescribing solution from eco-design to end-of-life management.
Ultimately, end-consumers, being more and more aware of sustainability, play an increasing role in driving change, using their communication powers through social networks (name & shame).
Hence, given the political, ethical, sociological, ecological and economic contexts simultaneously converging on sustainability to overcome the challenge of keeping a clean and viable world for future generations, this study envisions to set a status on the state of the art situation and identify existing or potential solutions contributing to reducing the GHG footprint of logistic packaging. It is done within the framework of a packaging distributor and therefore contributes to enhancing the value proposition for green(er) solutions.
In order to cover sustainability in logistic packaging, a thorough analysis of context, status quo, major drivers and trends will be made, relying on both secondary and primary sources.
Packed product characteristics (perishable or not, controlled temperature, …), distribution channels (with emergence of on-line business as an alternative to mass retail chains), packaging material characteristics regarding sourcing and recyclability as well as waste management (collection and recovery) and recycling facilities will be analyzed to identify improvement areas for an enhanced compliance to sustainability and a positive contribution to the environmental targets.
Based on primary and secondary data and information collected and analyzed, findings, guidelines, recommendations, identified best practices as well as existing and potential solutions will be made in order to provide to the FMCG industry and distribution (retail, e-commerce and omni-channel[8]) with a more sustainable approach towards logistic packaging.

[7] The initial definition of Sustainability – remaining still the reference – has been given by the (Brundtland, 1987): *"Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs".* Sustainability is consequently threefold: economic, social and environmental (A.Remmen, Jensen, & J.Frydendal, 2007). It encompasses all the activities of a company and has been transposed into organizations as CSR (Corporate Social Responsibility).

[8] Omni-channel: all distribution channels – off and on-line- offer the same experience and can be served with one product; in this case, logistic packaging.

2 The Context of Packaging

2.1 Types of Packaging

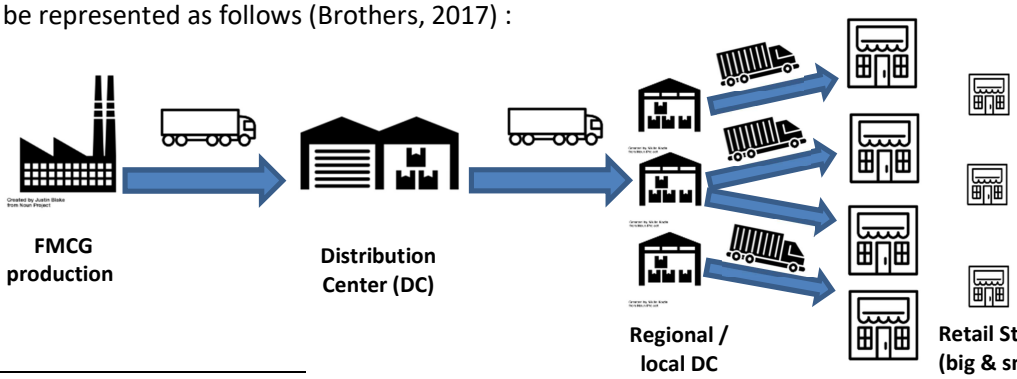
2.1.1 FMCG

FMCG stand for "Fast Moving Consumer Goods". They are composed of food and non-food non-durable products (product useful life below 1 year) with fairly low nominal value and high re-purchase frequency[9] (Brothers, 2017). FMCG rely on retail distribution in order to market their products. Their respective supply chains are complementary and inter-dependent bringing products from production sites to point of sales. Therefore, an analysis of FMCG cannot be conducted without looking at the downstream aspects of distribution. Although FCMG are (still) fast growing in emerging markets, they are facing challenging trends in Western economies, alternating good and bad years[10]. This is exacerbating the highly competitive spirit not only within the FMCG companies but also for retail chains. This is materialized in annual negotiations where brands can see erosion of volumes and/or profitability. This context leads to a strong tropism for cost optimization on both sides. These industries use standardized and proven processes for production factories and supply chain worldwide. Consequently, because FMCG are global, sustainable solutions developed in one place can be adapted and transposed all over the world. especially into areas where sustainability has become key for ecological survival. Additionally they can be implemented more easily because taken into consideration from conception phase (eco-design not only for product and packaging but also for infrastructures) as they constantly re-organize their footprint and invest into new facilities. For all the above mentioned reasons, FMCG industry and associated retail distribution networks are an interesting and relevant field of study. This study will not differentiate food and non-food products as most HACCP[11] points for food product safety are generally covered with primary packaging.

Packaging is answering the need to protect selling unit / products and then move this selling unit from production site ultimately to point of sales.

The traditional FMCG supply chain is split into FMCG manufacturer (brand owner or not) and the retail distributor. It also often involves third-party logistic companies.

It can be represented as follows (Brothers, 2017) :



[9] Because this study focuses on France, pharmaceutical and tobacco industry will remain out of scope as they follow a specific and controlled supply chain.

[10] http://www.nielsen.com/fr/fr/insights/news/2018/grande-consommation-en-france---un-bilan-2017-encourageant.html

[11] HACCP = Hazard Analysis Critical Control Point: methodology for food safety risk identification.

As it can be seen from the flowchart above, the challenge of sustainability needs to be tackled at different levels, with different actors and in various ways:

Firstly, transportation is everywhere at around five times on average from production to store (Fischer & Lilienfeld, 2017) and cannot be always avoided. When storage and transportation are involved (except from store to home), so is logistic packaging.

(Fischer & Lilienfeld, 2017), (Brothers, 2017) and (Hugrel & Palluau, 2014) classifies packaging in two main categories:

1- Retail packaging (or primary) corresponds to a "selling unit" in point of sales: packaging is containing and protecting the product, supporting all marketing allegations, communicating brand image and giving information such as product composition, instructions for use or legal disclaimers and barcode. This primary packaging ultimately enters consumer's home.
2- Logistic packaging (or secondary/tertiary) is the disposable packaging, in most cases remaining hidden from (and unknown to) the end-consumer. It is used, for FMCG, to group products together for optimizing supply chain operations. This packaging can be removed from retail selling units without changing product characteristics[12]. Two levels of groupings can be distinguished:
    a- First level = secondary: retail selling units are grouped into a more standard unit load (generally corrugated case) defined by its shape (stackable), size and weight (ease of storage and manual handling in retail stores) which is a key driver for retail chain to ensure labor time and costs optimization when restocking store shelves. This box is generally disposed when products are shelved. However, specific boxes, called shelf-ready packaging [SRP][13], are a multi-purpose packaging serving both logistic and retail. They are directly put on the shelves in order to save process time and speed-up the shelf re-filling process. Specific products, such as fresh and perishable food, could also be directly put into re-usable and sometimes foldable plastic or expanded polystyrene (EPS) containers (Conseil National de l'Emballage, 2017) & (Efficient Consumer Response Europe (ECR), 2007).
    b- Second level = tertiary: secondary packaging boxes are in turn grouped into a larger volume. They are generally piled up on a standardized pallet and either strapped or filmed – or both. Main target of wrapping packaging is to ensure pallet stability, thus avoiding people injury or product damage in case of a pallet collapse during transport and/or storage[14].These unit loads can move securely and conveniently through the entire supply chain, from production plants to logistic platforms, to retail stores stocks and, ultimately, up to the supermarket aisle until products are shelved.

[12] However, logistic packaging does not include containers devoted to sea, air, rail or road transportation.
[13] SRP = Shelf Ready Packaging includes on-shelf trays, pallet boxes and re-sable plastic trays for ready-to-sell and display ready
[14] Load stability is governed by norm EUMOS 40509, ; http://eumos.eu/quality-standards/

An illustration of a packed consumer product pallet is shown in image below:

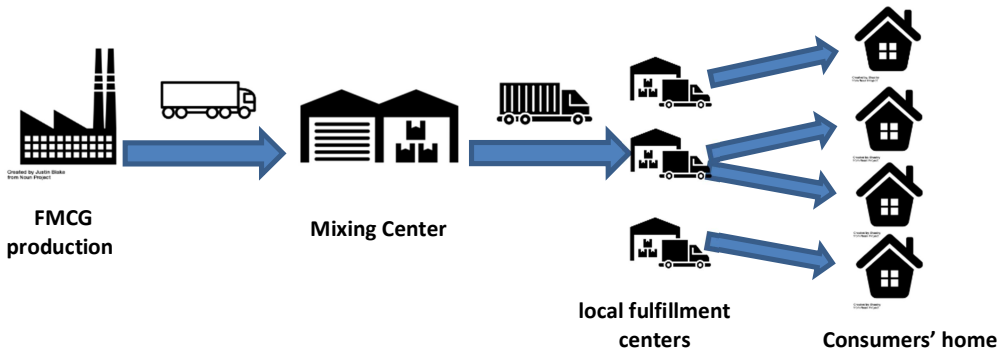
2.1.2 On-line

Alongside the more traditional “brick and mortar”, emergence and fast-growth of e-commerce is altering the well-established model, following a significantly different pattern, from purchasing and through supply chain.

Hence, logistic packaging plays a slightly different role: it is of course fulfilling its primary objective to protect a product (single or few heterogeneous products grouped together in one container: box, bag, other …) during transportation until point of delivery – generally consumer’s home-, but it is also contributing to a unique (or not) consumer experience (Fischer & Lilienfeld, 2017): only in e-commerce logistic packaging is the first element to touchpoint with the consumer.

Generally, e-commerce packaging is about 1 parcel for 1 product; but it can well be a basket of several/numerous heterogeneous products (grocery shopping) to fit into one or more box (Ballot, 2016).

Whatever the channel, products depart from the same production site. But when sold through on-line channel, they experience a significantly different supply-chain flow until it gets in the consumer’s hands (Rashbrook, 2017) & (Fischer & Lilienfeld, 2017).



Traditional retail and e-commerce are already and will increasingly converge[15] as buyer behavior is changing. More convenience (home delivery) and more omni-channel experience are required as buyers purchase the same consumer goods through on- or off-line channel, depending on which channel is available and more suitable at the time of purchase (Rashbrook, 2017).

This study will focus on FMCG through existing traditional retail. However, given the aforementioned evolution, some parallels will be made with e-commerce for a potential more global approach and convergence of logistic packaging for a global sustainable solution.

2.2 Materials used for Packaging

Overall, materials used for logistical packaging belong to 3 main families:

- Wood for mostly pallets
- Paper and board (corrugated and Kraft paper) for boxes, interlayers and corner protection
- Plastics (HDPE, LDPE, PP and PET) for stretch or shrink films, strapping, corner protection and re-sable pallets and boxes

Each material is more or less devoted to a type of logistic packaging.

2.2.1 Pallets

Pallet has become the standard for logistics in the 1970's when growth of consumption and development of mass retail increased the need for transportation between production sites and purchasing locations. Over almost 50 years, manufacturers[16] efficiently optimized production, use, repair, reuse and disposal of pallets (Roussel & Svilar, 2015).

Pallet can be made of wood, metal, plastic and now corrugated (Pearson Specter, 2018) and is exiting in various sizes. For FMCG, 2 sizes represent the bulk of the volume: the standard 1200x800 Euro pallet and 600x400 half-pallet. These sizes allow optimum loading plan for semi-trailers with 33 Euro pallets.

In France, wooden pallet (new & refurbished) represent 95% of the market (Roussel & Svilar, 2015) – the reminder being split between metal and plastic, corrugated being still anecdotal.

Pallet industry is centered on 3 major actors: pallet manufacturers, pallet rental companies and pallet refurbishment companies. All of them are contributing to making this industry efficiently organized.

In terms of sourcing, pallet industry relies on mainly two options, both being sustainable. It can be either wood coming from sustainably managed forest (FSC / PEFC)[17] or it can be wood coming from tree-

[15] Amazon and Whole Foods, retailers on-line: Auchandirect, decathlon.fr, FNAC.com …

[16] Although associated to Packaging, pallet is a bit hybrid because pallet manufacturers are not into packaging industry but limber industry.

[17] FSC was created in 1994 following the Rio Earth Summit of 1992; its role is to ensure, through certification, that limber actors manage properly and sustainably the wood resource. It is a highly recognized label.

thinning (that would have been either discarded or used as wood fuel). Although sustainable, wood resource could be considered finite as regeneration can be longer than consumption time. This gap can partially be closed by extending the lifetime of a wooden packaging. The slow growth of timber compared to increased usage created an un-balanced demand/offer resulting into price increase in Q4 2017[18].

Regarding end of life, decommissioned pallets are grinded into wood chips used for industrial heating (80%) and for construction (20% with wooden walls and timber frames & structures) as well as composting for agriculture. This resource is substituting construction materials or fossil energy, big providers of waste and CO^2 emissions[19]. So wood never constitutes a final waste since even its end of life benefits to economic agents.

Wood is also considered as a CO^2 stock. This characteristic allows granting pallet a negative CO^2 emissions balance (Roussel & Svilar, 2015).

2.2.2 Boxes

Boxes are mostly made of corrugated board for a single use and dispose. They can also be made of plastics allowing re-use. Boxes are the most used secondary packaging. They allow grouping of Selling Units into an easily manually handled unit for in-store manipulation: the Logistic Unit (Conseil National de l'Emballage, 2017). The corrugated can sometimes be printed with either brand image or logistic instructions to ease the product recognition and order preparations in warehouses (Conseil National de l'Emballage, 2017).

In traditional retail, pallets of open or closed boxes of products are brought into the store aisle, products are manually shelved and corrugated box is flattened and collected for evacuation. In case of a Shelf Ready Packaging [SRP], the same process occurs but when empty boxes are removed from shelf and replaced by full ones.

When it comes to e-commerce, this box is both a logistic item and a consumer over-packaging. It then contains cushioning and/or void-filling materials [20] in order to ensure product protection from damage during all the steps of logistic chain, from fulfillment that can be manual or mechanical until the “last mile” which can be critical in terms of parcel exposure to shocks and compression[21].

Corrugated is in its vast majority a single-use product already achieving a high recycling rate (96% in 2013 (Haeusler & Berthoin, 2016)). If 100% recycling can be achieved , 100% recycled corrugated is an illusion as it need to mix virgin fibers (25%) with recycled pulp (75%) to ensure required mechanic properties of corrugated (Confederation of Paper Industries, 2017). Virgin fiber is generally sourced from a certified

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PEFC was created in France in 1999 and became a worldwide organization in 2001. It is the world leader of sustainable forestry certification.

[18] http://www.epal-france.fr/2018/02/19/hausse-prix-bois/

[19] http://www.sita.fr/bois-et-palettes/

[20] Cushioning / Void-filling are packaging materials used to protect a boxed product to mitigate break risks resulting from impact

[21] https://www.60millions-mag.com/2016/11/29/livraison-domicile-pourquoi-tant-de-problemes-10811

origin like PEFC and FSC[22] which grants a sustainability guaranty. Corrugated, especially brown, benefits from a good sustainable image in the consumer's view.

2.2.3 Films and Strapping

Films and strapping bands are used to secure the load on the pallet. This aspect is fundamental to ensure cargo stability and safety during transportation and storage[23]. They can be used separately on jointly. Films, both stretch and shrink, are made of LDPE (or LLDPE), a fully recyclable material[24]. They can be transparent, white or colored. Strapping is a thin band of PP or PET, used to secure loads on a pallet. It is also used for e-commerce boxes as an anti-theft protection mainly preventing any unauthorized box opening.

Plastics are suffering from a strong negative image. This is reinforced with all reports on plastic pollution, especially in the marine environment. Many countries, as France, have banned or restricted usage of plastics packaging for their lack of biodegradability. It is commonly agreed that 400 to 450 years are necessary for plastic films to fully degrade in natural conditions. Plastic directly littered in nature (including landfill) is causing immense damages to the nature and wildlife. NGOs are using media hype around these dramatic events to alert and sensitize population[25] and drive behavior change.

It should not hide the fact that plastic has some sustainable aspects: it does not require lot of energy for manufacturing and, thanks to its light weight, actively contributes to reducing load transported and associated GHG emissions linked to freight. Films are now considered more as a commodity than as a technical product. It is nevertheless highly technical. Thickness down-gauging not exceeding few microns while maintaining mechanical specifications through several layers of PE, sometimes bi-oriented for higher resistance is achieved at industrial scale.

From an economic standpoint, plastic is rather unexpansive due to raw material and production costs. Indexation to oil price is impacting PE and PP indexes such as ICIS, resulting in increased price volatility.

2.2.4 Ancillaries (interlayers, corner protection, labels …)

Ancillary packaging materials comprise all additional elements not directly containing cargo but necessary for the overall cargo stability and protection and for logistic information.

Interlayers main purpose is to avoid cargo movement thanks to anti-slip characteristics. They can be made of plain board or corrugated PE. They are necessary mainly for non-boxed products (e.g. bottles) in order to increase stability due to little overlapping surface.

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[22] See note 17
[23] See note 14
[24] See appendix 8.6
[25] https://www.wwf.fr/vous-informer/effet-panda/bruxelles-contre-plastique
https://www.google.de/search?rlz=1C1GGRV_enFR783FR783&ei=Js4YW9_qMcz7UNHRmYgN&q=baleine+morte+plastique&oq=baleine+morte+plas&gs_l=psy-ab.1.0.0j0i22i30k1.2070.2524.0.4082.4.4.0.0.0.0.184.463.0j3.3.0....0...1c.1.64.psy-ab..1.3.461...0i22i10i30k1.0.0KD7DN5AsDs

Corner protection helps avoiding goods damages resulting from tight strapping. They are generally made of cardboard but can be made of PP plastics.

Adhesive tapes are used to close boxes. They are made of PP or PVC. They are mostly not recyclable because of glue, solvent and silicone added to provide adhesive characteristic. They also contribute to recycling feedstock quality downgrade as introducing externalities into recyclable material (corrugated).

Self-adhesive labels are also very important as they carry all relevant information to ensure traceability throughout the supply chain. They can be made of adhesive paper or PE plastics. They are printed on demand and added (glued) directly on the pallet wrapping. Although not costly, label is a highly sensitive article as it ensures supply chain efficiency. It gives the right information (selling unit, logistic unit, barcode and global location number (GLN), delivery place …) - generally written and bar-coded – to be recognized by optical readers as well as by warehousemen.

Document pouches are an alternative to self-adhesive printed labels; they are stuck on film or box and contain a label printed on paper and inserted into the pouch.

2.2.5 Comparative Table: retail vs on-line distribution channel

Supply chain has a strong influence on logistic packaging. Depending on product weight and volume, distance to be covered, break of loads and many other factors guiding choice of logistic packaging can be manifold.

Retail	e-commerce
	Protective in-the-box packaging (cushioning and void-filing – all types)[26]
Corrugated boxes (closed or open)	Corrugated boxes (closed)
Pallets / interlayers / corner protection / strapping bands / tape	Strapping bands / Tape
Films (stretch & shrink)	Shrink films / bubble wrap
Labels / document pouches	Labels / document pouches

An important overlap exists on these two categories in terms of product groups but details can differ.

However, some research suggests that FMCG packaging current formats might not fully fit the specific needs of e-commerce (especially the last mile) and new solutions have to be developed (Fischer & Lilienfeld, 2017).

Nevertheless, lessons learnt from one side can provide the other side with valuable inputs, especially with increasing on line shopping (grocery or other but especially grocery as implying heterogeneous products – comparable to small store delivery).

[26] See note 20

2.3 Market and Key actors

FMCG logistic packaging market is not easy to define. Many sources have been necessary in order to approach a value. It can be estimated for 2016 at EUR 25.2 billion worldwide and EUR 1.1 billion just for France and growing to EUR 1.5 billion by 2022[27].

Key actors of this market are numerous and their interactions can be multiple.

First[28], Packaging manufacturers either produce according to, market standards or their own specification or even make packaging according to particular customer specifications (and this could also go through converters for the made-to-measure part). Packaging manufacturers are addressing their market directly when certain conditions of volumes and order frequency are met. They also address smaller volumes or specific needs through B-to-B packaging distribution and converting.

Then, Industrial FMCG companies are chronologically the first and the biggest consumer of secondary and tertiary packaging. At the end of production lines, pallets are built-up by stacking secondary packaging and then strapped and/or filmed. Packaging products must fit high-speed fully-automated production lines. The primary target is to meet quality and regularity standards to ensure flawless production process.

Next, 3PL are specialized logistic companies ensuring on behalf of their ordering customers (FMCG or distributors) the transportation of the goods from production site to stores, going through a certain number of distribution centers.

After that, Retail distributors market the FMCG products in their stores. Store size can range from few hundred square meters to above 20.000m² for the largest. They are using logistic packaging to prepare store replenishment orders organized by pallets or roll-cage trolleys.

Finally, Waste collection companies and recyclers are closing the loop. Their mission is to remove the waste (including packaging waste) from all locations (industry, logistics and distribution). Waste is sorted and either recovered in energy production or recycling; if not recoverable, it can go in landfill. Recyclers procure the recycling raw materials from waste management companies. Often, waste management companies have developed their own recycling capabilities.

2.4 Other stakeholders (NGOs, NPOs, Customers, shareholders…)

Many NGOs and NPOs[29] are active in the field of sustainability. Some of them are historical, such as Greenpeace or WWF and have acquired their respectability over the years of action for better environment. Some of them are more recent, such as CDP (formerly Carbon Disclosure Project) or Global Reporting Initiative (GRI) and have gained trust through their serious work based on independent

[27] See appendix 8.1
[28] Raw material suppliers for pallets (wood), corrugated (pulp) and plastic packaging (plastic polymers) are not covered in study.
[29] See appendix 8.4

assessment of compliance to UN Global Compact and following policies. They have set standards now internationally recognized and used by major industries, among which FMCG companies.
They actively work into defining and supporting implementation within Energy and FMCG sectors of strategies and actions aiming at emission reduction. Other type of NGOs, although not dedicated to sustainability, are playing an increasing role: for example World Economic Forum or Consumer Goods Forum and many others contribute with a more business and economic view on this topic that they now consider as key for the future: sustainability.

Professional associations aiming at monitoring regulatory and technical landscape evolution, analyzing trends and developing operational excellence within their sectors enter as well in the influencers' category. They issue more and more white papers on sustainability and can actively contribute to spreading best practice within their industry.

Shareholders & investors are as well increasingly looking and influencing CSR policies of companies. Global warming resulting from GHG emissions creates adverse weather risks potentially affecting assets and business and -2°C trajectory of companies induces low-carbon transition risks. Both risks can affect company's performance over time, thus valuation (Hubert, Nicol, & Cochran, 2017). This is also encouraged – or incentivized – by the article 173-VI aiming at aligning investment portfolio and de-carbonation trajectory (Forum pour l'Investissement Responsable (FIR), 2016) or by the UNEP Principles for Responsible Investment (2006). Recently, NGOs publically asked Black Rock's[30] CEO Larry Fink to walk the talk and influence sustainable behavior of companies of Black Rock portfolio and exit carbon-intensive activities (Rolland, 2018).

Ultimately, individuals, be it customers or employees, are also playing a growing role. They claim for more sustainability from their employers and/or from their preferred brands. But by requesting better products at cheaper price, they force companies to look for most cost efficient solution. And when facing a bad packaging experience (both excess primary and secondary for e-commerce), some consumers are prompt in "naming & shaming" and sharing this with full details and pictures on social networks (Rashbrook, 2017). Employees also request more and more a sustainable behavior from their employers. They can quit a position if policy is not in adequacy with their beliefs. FMCG companies and distributors, generally building their brand image through customer proximity, want to stay away from this type of bad publicity that could affect brand reputation and customer loyalty.

All these direct or indirect, minor or major "influencers" play a more or less important role in the transition to more sustainability. The variety and quantity of these influencers make it difficult for Consumer Goods and Retail companies to avoid tackling sustainability.

2.5 Relevant Packaging Legislation and Standards

Sustainability is, in many countries, governed by laws, directives which are, to a certain extent, transcription in national frame of upper level directives set-up by supra-governmental bodies such as EU

[30] Black Rock is the biggest Asset Management company with USD 6288 trillion assets under management

or UN and this since quite a long time. The European directive 94/62/EC on "Packaging and Packaging Waste" issued on December 20, 1994 is the cornerstone of packaging sustainability approach. It has been updated several times, especially with decision 2005/270/CE whose targets are:

- Generalization of EPR (Enlarged Producer Responsibility)[31]
- Priority given to packaging waste prevention and recycling through precise guidelines in regards to packaging optimization, material content (hazardous materials) and end-of-life management.

In France, the various European directives have been adapted and integrated over time into "Code de l'Environnement". This legal framework establishes a clear distinction between EPR for household waste and non EPR for retail and industrial waste.
Retail and Industrial Packaging waste is governed by articles R.543-66 to R.543-74 of "Code de l'Environnement" stating that packaging holders shall make their best efforts to sort and recover as much packaging waste as possible, themselves or through authorized professionals.

Legislative corpus is abundant and encourages transition to greener economy. However, it is complex and ranked #3 in the top 6 main constraints towards more sustainability (Roland Berger Strategy Consultants, 2010).

There are other laws and regulations indirectly influencing logistic packaging, influencing its size and shape: Norm EUMOS 40509 on load stability or labor law articles R.4541-5 & 6 relating to occupational disease and injury prevention resulting from manually handled weight (Conseil National de l'Emballage, 2017).

Laws and regulations are also complemented by standardized norms and best-practice rules.

This legislation and regulatory framework can be considered as Porter's 6th force on this industry[32].

[31] EPR, according to OECD, defines that producers are bearing the responsibility of post consuming end-of-life treatment and disposal of products they put on the market. (http://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm)
[32] Detailed overview of regulatory landscape incl. detailed articles relating to Industrial and Retail packaging waste are available in appendix 8.4 OECD, defines that producers are bearing the responsibility of post consuming end-of-life treatment and disposal of products they put on the market. (http://www.oecd.org/env/tools-evaluation/extendedproducerresponsibility.htm)
[32] Detailed overview of

3 Packaging and Sustainability

3.1 The business case for sustainable packaging

Logistic packaging too often remains an example of a linear economy approach in a world progressively converting to circular economy[33]. In many cases it is still, with single use products, the illustration of the tryptic – take-make-dispose - symbol of the linear model, despite an increasing waste volume oriented towards recovery and recycling. It is now commonly accepted that the consumption model lives on credit. Fossil or non-fast enough renewable resource compared to pace of consumption growth leads to resource scarcity, price volatility and supply shortage which can be harmful for business and companies (World Economic Forum, 2014).

A favorable context towards more sustainability started with creation of UNEP (United Nations Environmental Program) in the early 1970's. It was followed by Global Compact initiative started in 2000 which aims at converting businesses to a more sustainable and socially responsible approach. This is materialized by emergence of Corporate Social Responsibility. It grew stronger after the COP21 in Paris[34] which enacted a worldwide success of political and governmental commitment to climate change. The unpopular withdrawal of the USA combined to climatic disasters even reinforced the phenomenon. Many large FMCG & retail corporations, already engaged into CSR, seized this opportunity to boost their sustainability policy towards more climate-related and environmental actions (Bertrand, Hershey, & Miia, 2016). They did so not only for environmental reasons but also because they expect future growth based on these policies (Rao, 2013). Announced increase in CO^2 tax with a 233% increase in the next 12 years (from 30€ in 2017 to 100€ in 2030[35]) should also encourage change of behavior in regards to fossil-based raw material sourcing, transport and material recovery. Specially, FMCG & retailers have a common challenge to make mass consumption more acceptable from a sustainability stand point. As they are very exposed to consumer scrutiny, they need to collaborate in order to select best sourcing options and reduce waste generation along the value chain. This is not always easy but absolutely necessary to scale-up circular economy to global level (World Economic Forum, 2014).

Logistic packaging impact on logistic efficiency (including transport efficiency) can fully support GHG emissions reduction actions pursued by consumer goods economic players.

3.2 Current practices

[33] Circular economy is often referred to as "cradle to cradle" meaning that waste becomes raw material for new products/applications while linear economy is referred to as "cradle to grave" with post-use disposal when products become final waste.

[34] COP 21: held in Paris in Nov-Dec2015 under the high patronage of the UN; where 176 over the 197 present countries (89.3% - https://unfccc.int/process/the-paris-agreement/status-of-ratification) adopted resolution to contain global warming between 1.5 and 2°C until 2100. This is directly targeting reduction of CO^2 emissions responsible for global warming

[35] See appendix 8.9

3.2.1 Sourcing

Generally, footprint of pallets and corrugated packaging suppliers is local. These articles are produced in the area of consumption because transport cost is rather sensitive with high volumes / light weight and product quality could be affected by climatic condition change (hygrometry) (Conseil National de l'Emballage, 2014).

However, these rules do not apply to plastic packaging products. Suppliers are more spread as transport is less critical for these types of products. Hence, stretch and shrink films as well as tape can be produced locally or can be imported from overseas (Brazil, Malaysia, China or the Persian Gulf). Therefore, it is likely that GHG emissions are not considered in the global equation of such sourcing.

3.2.2 Use

Still in numerous cases, homogeneous pallets out of production are broken down in distribution centers with unpacking, order preparation and repacking process. Heterogeneous mixed products on pallets are then proceeding to the next supply chain step until store. Almost each of these steps is generating one way disposable packaging usage and waste (mostly films, strapping and labels). As displayed in § 2.1.1 and § 2.1.2, different supply chain schemes have emerged over time (Brothers, 2017). For store delivery, several devices and logistic flows are used. Consumer goods typology, retail store size and delivery frequency imply usage of different packaging options. Pallets (wooden or plastics) or roll-cage trolleys are filled with very heterogeneous products and delivered, sometimes on the street/sidewalk (see picture 6, p.64). However, some efficient packaging and supply chain have been developed for some heavy or voluminous products like liquids/beverages. They are delivered directly in full or half pallets inside stores: direct store delivery (DSD) (Badouix, 2018). Another often used scheme is cross-docking (Trohay & Lucot, 2018). Full pallets of products are delivered on a mixing platform where they are consolidated with other pallets of other products in order to send one truck to one (or more) store(s). These two schemes allow saving breaks of load, product manipulations – unpacking and repacking operations - and sometimes freight.

Although it does not constitute a genuine target, sustainability is incidentally reached thanks to packaging reduction and optimization – with economic rather than environmental motivation. Key driver is efficiency to keep direct labor as low as possible all along the value chain. From production to waste management (especially in labor intensive retail) maintain low manpower involvement reduces costs and risk of damaged products (Badouix, 2018).

In the supply chain, the most unsustainable element is not logistic packaging as it is mostly composed of fully recyclable materials. Freight, together with storage (especially temperature controlled), are one of the main GHG emission factor for FMCG and Retail (Berruti, Giorgi, & Morgan, 2017)[36]. These emissions are measured as transport is fully incorporated into consumer goods LCA as these emissions are included

[36] For example, refrigerant accounts for respectively 42% in food manufacturers and 30% in retail while truck fleet accounts for 56% of total CO^2 emissions.

in scope 1 and 2 of manufacturers and retailers[37]. This is why professionals actively work on energy efficiency and CO^2 reduction plans.

Urban logistics are becoming a more and more challenging topic (Braouzec, Bros, Genestier, & Samson, 2018). This is affecting both retail and e-commerce deliveries with traffic congestion and sometimes restrictions. As an example, for internet deliveries, 21% of parcels are not delivered in the first delivery loop[38], causing more trucks on the road, more traffic congestion and negatively impacting the CO^2 equation. The major area of improvement in this field is load optimization. If fulfilment of 100% load capacity is not realistic, there is room for improvement as many trucks on the road are running in average at filling rate of 50% or lower capacity (Ballot, 2016). Logistic and freight forwarding companies - which often act as subcontractors - are at the heart of this problematic. They are also at the cross-roads of retail and e-commerce as their infrastructures (trucks and warehouses) are a critical link from production to end-customer either via traditional or on-line retail (Rashbrook, 2017). Their main contributions in regards to sustainability are on fuel efficiency [39](through vehicle fleet matching the highest standards and through driver training to eco-driving), cargo optimization through adaptation of truck to bulk density and reverse logistic. Some large freight forwarders are even working on cube optimization by developing optimal secondary packaging for their customers (XPO Logistic, 2018).

3.2.3 End of Life and Recovery

Products or material end of life can happen at any stage, from production to final use. Recycling of production waste is a reality since years in packaging industry: at converters for corrugated (Confederation of Paper Industries, 2017) and directly at production sites for films extruders (Dirnberger, 2018). Once again; this trend is more geared by economic (waste is a cost) rather than environmental motives. Modification of productive equipment is generally required. Waste sorting and collection occurs at each step of the full supply chain: from FMCG production sites until retail stores or consumer home for e-commerce. Obviously, several regulations apply. If an industrial, logistic or large retail site is under the “economic activity waste” umbrella (art R541-8 of “Code de l’Environnement), urban area small store waste is assimilated to household waste (art L2224-14 of “Code général des collectivités territoriales”) (Haeusler & Berthoin, 2016). It is disposed together with primary packaging and e-commerce packaging waste. This difference of applicable waste management plays a key role in waste recovery efficiency. The traditional simple and limited material of logistic packaging is then mixed with household waste which is by far more heterogeneous (and not covering flexible plastics until end of 2022[40]), thus complicating recyclable material identification inside the sorting flow and generating high rejection rate of in average 35%, all this contributing to a lower recycling rate (Haeusler & Berthoin, 2016).

Waste sorting inside industrial, logistic and large commercial facilities is generally well organized as it is a legal requirement and an operational necessity.

[37] CO^2 emissions scopes: scope 1 include all direct emissions linked to manufacturing/distribution; scope 2 includes all indirect emissions linked to energy production; scope 3 includes all other indirect emissions, up and downstream

[38] Source FEVAD : based on a sample of 40 million parcels delivered by 20 freight forwarders (https://www.60millions-mag.com/2016/11/29/livraison-domicile-pourquoi-tant-de-problemes-10811)

[39] In last 20 years, road freight emissions of polluting gases decreased by 80% and fuel consumption/ton decreased by 20% (source FNTR)

[40] Eco-Emballage/CITEO extension des consigne de tri

If recycling remains the best option for packaging waste, other solutions are in place, depending on the source location (proximity or not to sorting facility and/or waste incineration plant) and the associated waste collection organization. Thus, industrial factories in rural areas not equipped with sorting and/or incineration infrastructures might well see their waste going to landfill (Haeusler & Berthoin, 2016). Although not ideal, energy recovery can represent an acceptable alternative to landfill with two favorable effects: it reduces both long-term waste impact on the nature and use of fossil fuel for energy production (Sustainable Packaging Coalition, 2011). Landfill still exists and remains the #1 waste downstream channel in France with 28% (direct allocation but 34% after re-allocation of other channels), before energy recovery (25%), and recycling (20%), the remainder being split among composting and methanization. In addition, among the 35% of waste not accepted after sorting, 15% is going to energy recovery and 20% to landfill (Haeusler & Berthoin, 2016).

3.3 Challenges of Sustainable Logistic Packaging

Fulfill the circular economy requirements while being economically attractive remains the main challenge, especially in the Consumer Goods highly competitive environment. But sustainability is a very wide and complex topic as it encompasses all factors directly or indirectly influencing natural resource, environment preservation and human protection. Even restricted to logistic packaging, it requires a deep knowledge of materials, flows, interactions and interconnections between industrial, commercial and waste management to be able to properly address this subject.

Although sustainability aspects are known to and expected by packaging buyers, they do not prevail. The top 3 packaging criteria according to (Conseil National de l'Emballage, 2017) (several choices possible):

- Product protection / cargo safety
- Freight and storage fit
- Marketing and customer information
- Costs and cost reduction
- Ecology / recyclability

All these points are strong expectations but sustainability aspects come #6, corroborating all testimonials and observations: economic considerations come ahead of sustainability. Additionally, a recent study[41] showed that 40% of purchasing managers considered sustainable purchase as a priority while 60% as just one element among others. There is a gap between the mid- and long-term corporate willingness and commitments to converge towards sustainability (Tebbe, 2017) and the short-term (daily) basic objectives of operations. This is making more difficult to push sustainable solutions based on corporate policy since operations are quite disconnected from Strategy and purchasers focus on price and functionality matching a given target to achieve at quarter-end (Saporta, 11/2015).

Last hurdle but not the least is the numerous actors along the value chain that would be affected by a change, from packaging manufacturers and converters to logistic providers, from industrial and retail to

[41] Opnionway pour l'observatoire des achats responsables – baromètre 2018 (Fev 2018)

waste management companies (Rao, 2013). To overcome these difficulties and allow all players to collaborate on these global issues (among which sustainability and environment) without impeding competition, the Consumer Goods Forum was created in 2009. Since then, many workshops have been held between all industry contributors and guidelines issued to support transition towards more sustainable packaging (Consumer Goods Forum, 2011).

The full "6 RE Philosophy" mentioned by (Remmen, Landfield, Saur, & Astrup Jensen, 2006) is an approach that can be applied to reach better packaging sustainability.

Re-duce

From a sustainability standpoint, the best packaging is the packaging that never existed. Is it feasible? Not really because products need to be protected throughout supply chain. If suppression seems not to be an option yet, reduction is in many roadmaps.

Reducing but keeping the same convenience and protection functionalities is a real challenge but a key success factor for logistic packaging. Optimum use would imply less material, to reduce direct and indirect (production and transport) negative effects. This is generally achieved through eco-design. Eco-design is mainly used for primary packaging, triggered by eco-contribution, consumer perception and high direct costs. Marketing still prevails in primary packaging design of consumer goods, especially when sales erosion needs to be countered by product evolution; this includes additional primary packaging, totally in contradiction with sustainability targets (Jadoul, 2015). It is also used for secondary packaging, specifically for pallet optimization or for SRP packaging. Sometimes eco-design also leads to material switch to gain volume and weight. However, some new materials introduced do not necessarily match recycling criteria. Eco-design should integrate the current recycling infrastructure (under-capacity or non-existing) for new products (Sustainable Packaging Coalition, 2011) as a truly sustainable solution should be valid today and not in a hypothetical future.

Packaging reduction – or more precisely packaging/product ratio optimization – constitutes the quickest and sometimes easiest route to sustainability, given the transport and storage GHG impacts. Higher density of products achieved thanks to secondary and tertiary packaging will mechanically impact favorably truck loads and storage capacity. Pallet optimization can be achieved with improved filling and more technical corrugated (thinner and stronger) and films (thinner and stronger) that will impact weight (improved gross/net weight ratio) as well as reduce logistic packaging waste. Optimum use would also imply re-use. But reducing weight is contrary to extended lifetime: to be used several times without needing adaptation or repair, a packaging needs to be stronger. Its weight and therefore CO^2 emissions linked to production and weight transported are impairing the sustainability equation. So if reduction cannot be achieved, then increased functionality at same cost should be targeted. The concept of SRP seen previously finds its origin in this approach. Combination of logistic packaging with optimum handling and point of sales display of valuable information for customers are key features of SRP (Conseil National de l'Emballage, 2017) & (Efficient Consumer Response Europe (ECR), 2007). SRP can sometimes

be a single use (when dedicated to a special promotional action at printed accordingly) and then could be re-used for corrugated waste evacuation (see pictures).

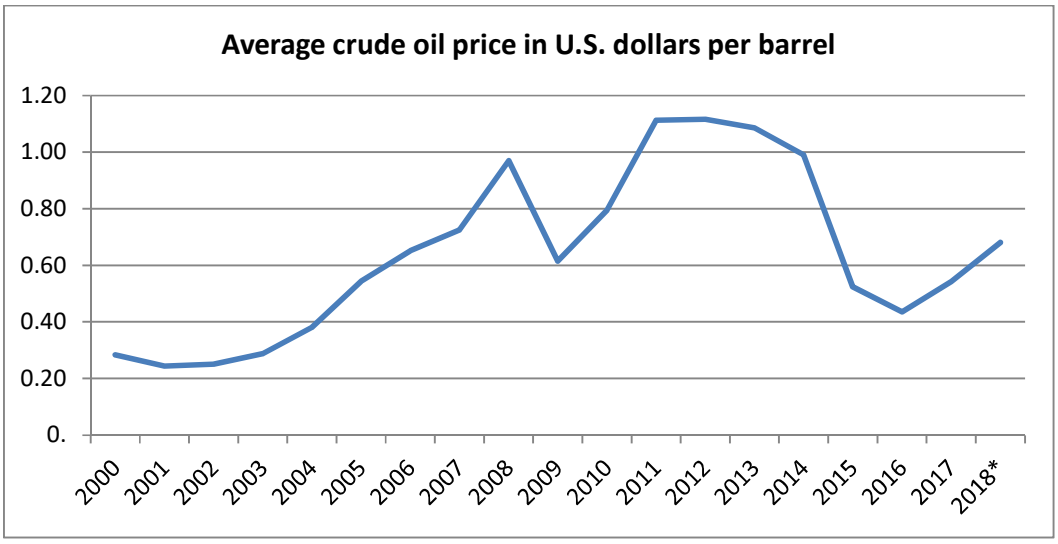
Re-cycle

Recycling is already a reality in many industrial or commercial locations. Infrastructures are in place almost everywhere; but where they need to be developed, it will require time and money. Optimizing recycling and making it possible everywhere can represent a benefit for both environmental and economic dimensions of sustainability. Current push in France is made on household waste. New approach will be needed in order to maximize industrial and commercial waste recycling through closer loops.

Some sectors are well organized and achieve already an optimum level of recycling. Pallets are a well identified re-usable packaging. They are managed in pools by industrial, pallet rental companies of 3PLs. they can efficiently be allocated to re-use, re-pair or recycle (Roussel & Svilar, 2015). Corrugated boards flows are also well identified and structured allowing allocating more than 90% to recycling (Haeusler & Berthoin, 2016). Plastic recycling volume is largely behind, due to complexity. Heterogeneity of feedstock (7 plastic families[42]) and incompatibility preventing mixing resins between themselves for recycling is hindering recycling. The current French plastic recycling industry is not able to absorb all volumes because if its lack of infrastructures (Dadou-Willmann & Harscoet, 2014), which is becoming a concern due to new plastic flow arriving in recycling. The target of 0% plastic in landfill (Jadoul, 2015) and the 100% plastic recycling (Demoux, 2017) could seem ambitious given the current situation of this industry.

French recycling infrastructure for plastic faces large under-capacity problems, representing only 6% of total European of flexible PE (Plastic Recyclers of Euope (PRE), 2018), explained by several factors. The high cost structure linked to plastic feedstock collection, sorting and preparation for recycling that cannot be covered by revenues generated from sales of recycled resin; export of plastic feedstock to countries with significantly lower labor costs (Dadou-Willmann & Harscoet, 2014) given the labor-intensive necessary activities; low recycled plastic demand in Europe (6% of total plastic demand) (European Commission, 2018) & (Demoux, 2017); few opportunities for recycled resins as virgin materials have regained competitiveness linked to low(er) oil price since 2015 (Saporta, 11/2015).

[42] See appendix 8.6



Source = OPEC by Statista

Recent events with China ban on waste import (Golla, 2018) vindicate this state of things. This situation created an overstock of collected waste resulting in a significant drop in recycling feedstock price - This was already the case in 2012 when Chinese recyclers focused on local rather than import sourcing, creating at that time a price drop in PE and PET recycling raw materials (Actu-environnement, 2013). History is repeating itself.

Stretch films can incorporate a maximum of 30% of recycled resin (ELIPSO, 2015) which is a limitation factor for recycled material use in a full closed loop. Same issue than with corrugated is faced but with a much higher proportion of a non-sustainable virgin source. However, PE films can fully be recycled for other applications like waste bags (ELIPSO, 2015). Plastic film recovery still presents some room for improvement, with for 2014: 2% re-use, 19% recycling and 53% energy recovery (ELIPSO, 2015). Recyfilm is the French eco-organism created in 1994 and devoted to flexible plastic recycling. After 20 years, achieving 19% recycling could be considered as a mediocre result but many factors explain this situation. First, plastic sorting is labor intensive and difficult because resins cannot be separated visually. Because of this, collected plastic in industrial and commercial channels was firstly sent to China benefitting from low labor costs, existing recycling infrastructure (China developed this capacity to reduce its oil dependency) and low sea-freight fares opportunity[43] (Dadou-Willmann & Harscoet, 2014).

Re-place

Starting point is the raw material used for packaging production. A sustainable packaging should be sourced from recycled or sustainable and renewable virgin origin, ideally traceable. In France and Europe, it can be considered as achieved for wooden pallets, corrugated and metal (pallets & roll cage)

[43] Europe-Asia sea freight costs equals road freight of few hundreds kilometers

since these sectors are well structured and organized for sustainable sourcing or virgin source[44] or recycled (Haeusler & Berthoin, 2016). For plastics, being mostly a fossil-based material, it is a more challenging topic. Hence, 100% sustainable cannot always been achieved but it can be pursued. Replace for a more sustainable product i.e. that is contributing favorably to the total equation might well be challenging. Any substitution that is improving one part but deteriorating another one cannot be considered sustainable. When developing or introducing new materials, awareness about recycling technical constraints, existing technology and infrastructure capability make the difference between theory and real life.

Bio plastics, although growing, are still not very well spread as the heavy investments in R&D and production capacity are harming its cost price. It is influencing selling price with a premium of 10 to 20% compared to oil-based materials (Rao, 2013). Its lack of competitiveness compared to traditional plastics is the main obstacle to development in a market dominated at 99% by oil based products (Huynh, 2015). Bio-plastics can be mixed with oil-based resins to produce packaging films. They can also be recycled together. Bioplastics do not necessarily mean bio-degradability and biodegradability does not necessarily mean recyclability. If bio-degradable plastic seems appealing, it might not be such a good idea; because bio-degradability conditions could not be met in nature, bits of micro-plastics could be found and ingested by wildlife (European Commission, 2018). Bio-plastics would therefore not deliver the promise of a cleaner nature. Bio degradable plastics could in addition be incompatible with recycling specifications of oil-based or bio-plastics because of the additives necessary for their bio-degradability characteristics. Bio-plastic application for stretch; shrink and strap represent an available alternative that will continue to grow at a pace indexed to the oil-based product prices.

But it is not only about replacing products. It can also be about replacing suppliers. A supplier being committed to sustainability through various approaches and certified accordingly like ISO 14001, ISO50000 for energy efficiency is preferable to a supplier not being certified.

Re-Use

Re-use applies to all or part of a packaging. E.g., for a packaging made of a box and a lid, box can be reused but lid disposed. It would still contribute to improved sustainability.

Development of returnable or multi-purpose packaging is also a growing trend among the industry.

Re-use can be apprehended in three main ways. First, in a closed-loop approach where packaging is coming back to its point of departure in order to be re-used for the same purpose. This is the case in retail for roll cage trolleys or some ready-to-sell boxes (SRP) for fruits and vegetables. Then, in a semi-closed loop approach where packaging is coming back to a pool for re-use (like pallets) or to the sender for finally disposal (like of e-commerce returns). Finally, in a fully open loop approach where re-usable packaging is totally changing its primary destination and can be re-used for any other purpose by the packaging holder. *E.g. the Nespresso delivery box than can be re-used as a shoe box.*

[44] PEFC and FSC for wood sourcing, see note 17

Additionally, re-use often implies sometimes dedicated storage space until collection and a reverse logistic scheme. But returning an empty packaging is sub-optimal for freight efficiency. This is why many solutions aim at reducing the volume of an empty box (collapsible box, efficient stacking). And the efficiency of the scheme lies as well in the quantity of packaging collected. While re-using is the basic business model for pallets and cage roll trolleys (generally used in pools for greater efficiency and flexibility), it is starting with box-pallets which can be considered both logistic packaging and SRP.

Re-pair

Repair is linked to re-use; it allows maintaining packaging into best working conditions to fully deliver its potential. But in order to have a packaging easily reparable, it needs to be "re-thought" and designed in such a way. This is only viable for high value packaging like metal trolley or plastic pallets or pallet-boxes as well as with high volumes of a very standard product easily substitutable like pallets. If re-use is planned to grow, then re-pair will as well. But evolution of supply chain – especially reverse logistics – needs to be studied to ensure non-functional packaging enters the repair flow in an optimized way. GHG balance and cost of repair should not exceed the ones of disposal.

Re-Think

Re-think is not limited to the product per se but includes the functions rendered by logistic packaging. Rethink the tandem product/packaging, optimize its ratio are among the possibilities often addressed. Not only should raw material be considered but the whole GHG impact along the value chain, starting with packaging material. Additionally to sustainable sourcing, corrugated industry is working to reduce production process GHG emissions. This industry needs high quantities of energy to process raw materials and manufacture products. It is estimated at 25% of total costs (Rao, 2013) – not to mention use of natural resources like water. This is why paper and corrugated industry has long ago started its conversion to biomass in order to step away from fossil fuel based energy (Smurfit-Kappa Group, 2017). When looking at the full global approach of CO^2 emissions, plastics are far less emitting GHG during transformation process as it requires less energy. GHG equation is unfavorable looking at raw material only but it is partially compensated by process when looking globally. Additionally, plastic film is very light and the product/packaging ratio is much more beneficial to film than corrugated[45].

Re-think the supply chain until the very end is a difficult topic. However, it should not be forgotten that logistic packaging induces grouping of homogeneous products while e-commerce packaging induce unitary /small groupings of heterogeneous products, with quick delivery and easy return functionalities (Fischer & Lilienfeld, 2017) & (Rashbrook, 2017). Transit packaging is optimized to the goods for FMCG to retail while e-commerce packaging is sub-optimized, being a trade-off between management of a certain number of packaging references (variety) and best suitable size given packed goods[46]. This difference will influence the typology of cross-business solution (Fischer & Lilienfeld, 2017). For a more efficient logistic

[45] no detailed LCA were available to perform a comparison between the various options
[46] "Packaging and the Internet: a guide to packaging goods in multi-channel deliveries", incpen, 01/2012

packaging serving both retail and e-commerce at the same time, best would be differentiation at the very end of the chain.

Today's investigations and tests into in-store shopping for internet customers and foot-deliveries or "drive-in" or "walk-in" pick-up[47] would solve several issues at the same time: CO^2 footprint of urban logistics for individual deliveries and better store replenishment with optimized truck rather than half empty trucks for internet deliveries. Additionally, it contributes to optimization of inventory and inventory turn avoiding dedicated stock for each channel thanks to a shared stock between physical store and internet offer. Logistic packaging in this case becomes a shopping bag or a disposable corrugated box or re-usable plastic case.

But re-think projects currently deliver only incremental innovation contributing to better sustainability.

The "Physical Internet" (PI) has the potential to revolutionize logistics and contribute to enhanced sustainability of the supply chain. This disrupting open-innovation project is based on 2 observations. First, logistic, the second biggest GHG emissions factor is totally under-optimized. Second, sea-containers disrupted world trade by allowing transporting any goods in a standard box. In the light of this, university researchers elaborated a two-fold concept. Standard containers of various sizes are managed independently from cargo. These containers are moved in the supply chain using a standard and shared open IT protocol. This concept originated from applying the internet way of working to logistic physical flows: to transport standard packages of goods (like data) across a network avoiding point to point deliveries and allowing optimized transportation and transshipments between big logistical hubs. This project is managed by scholars from various universities around the world, in North America (USA, Canada and Mexico), Europe (France, Austria, Germany, UK...), Africa (Morocco) and Asia (China and Korea) contributing to a research network. It triggered the interest of FMCG and Supply Chain players which are also supporting and monitoring this initiative. As an example, Consumer Goods Forum was an official sponsor of the 4th international Physical Internet Conference in 2017. Procter & Gamble, FM logistics and Chep[48] are also participating to workshops. The (Ellen MacArthur Foundation, 2017) is also promoting this project as it advocates shared re-usable packaging delivering 32% overall cost savings linked to better filling rate and up to 60% GHG emission reduction (Montreuil, 2017). This could even totally revolutionize the current logistic and associated packaging that dominates today (Ballot, 2016). The concept is highly technical and complicated. It implies conception of a full set of modular containers (potentially embarking IoT[49] devices) and development of software dedicated to cube optimization, container management for freight and transshipment in distribution centers. Modularity of the PI could also enable serving both retail and e-commerce (including "last mile") at the same time (Ballot, 2016). The whole challenge of PI project is to create an open-source standard that will then be adopted by the majority of the supply chain players. Supply Chain would then operate in an inter-connected network contrary to current situation with proprietary systems that do not allow full inter-operability. A universal system based on intermediation platforms would create a network economy, which would bring higher benefits than economies of scale (Ballot, 2016).

[47] Walk-in piéton: today available from Leclerc, Carrefour, Intermarché
[48] Chep is a company specialized in packaging rental (pallet, plastic boxes)
[49] IoT stands for Internet of Things: connected objects collecting data like localization, movements, temperature …

PI is currently moving from the research and simulation field towards physical testing. One application project, Modulushca has received EU funding to test a concrete proof of concept for the PI, demonstrating its relevance, feasibility and viability. Other test projects are taking place in North-America [50]. However, PI project is not foreseen to go live anytime soon. Time framework is 2016-2020 for research program while testing could extend to 2030[51]. Then various steps are planned until 2050 for a fully operational PI[52], if it ever goes live. But it would anyhow have contributed to a different way to apprehend logistic packaging and FMCG supply chain.

Sustainability is a challenge for the whole economy and not only for logistic packaging. What the literature studied and presented has evidenced will be complemented by results of interviews and field observations.

[50] http://www.modulushca.eu/index.php/the-project/objectives
[51] Source = Modulushca: http://www.modulushca.eu/
[52] Source = Road Map Physical Internet ; http://www.etp-logistics.eu/

4 Methodology

To perform this study, various sources of information have been used: both primary such as personal interviews of packaging experts, as well as waste management or sustainability experts, producers, retailers and industrial users, and secondary like academic research and publications on sustainability by governmental, supra- governmental and non-governmental, professional journals and websites.

However, interviews were more difficult to execute than anticipated. Persons interviewed represent the whole chain from packaging manufacturer to waste management, including packaging distribution sales, food FMCG purchasers, packaging experts, sustainability managers, and retail. With only few (9) respondents[53], information given will be qualitatively good given the profile of interviewed people (appendix 8.5) but representativeness could not be guaranteed. Therefore, qualitative contribution will be reflected but cannot be generalized as a trend among one industry.

Interviews were preferred to questionnaires in order to leverage contact, capture more qualitative data and be able to better apprehend the focus given to sustainability and evolution, blocking points regarding logistical packaging. Interviews were not recorded. Manual notes were taken.

Collected data has been sorted by theme in order to present and compare answers from the different players of the value chain on specific topics. This allows apprehending the different viewpoints on the same topic.

Field visits and observations were also used in order to corroborate information received with real-life experience. Around ten urban area stores of food and non-food distribution were visited. Store sizes range from less than 100m² up to 8.000m². This wide range of surface allowed observing different practices when it comes to consumer goods delivery, storage, shelf placement and waste evacuation. Some pictures in appendices are illustrating the different business cases met in these stores.

Secondary data are mostly coming from well-known official and reliable sources such as Ademe[54] or professional association publications (e.g. Elipso, Eco-Emballage, Sypal, Conseil National de l'Emballage[55]) as well as some press articles to demonstrate connection to current news and events. Smithers-Pira's[56] market reports and prospective analysis supported also this study.

Some technical data regarding pallets, stretch and shrink film recycling process rely on information presented by commercial companies during professional thematic conventions.

[53] See appendix 8.8
[54] Please refer to appendix 8.6 for more information
[55] Please refer to appendix 8.6 for more information
[56] Smithers Pira is considered the worldwide authority on the packaging, paper and print industry supply chains with more than 80 years' experience and regular market prospects publications.

5 Key findings

5.1 Logistic Packaging Sustainability: a soft focus from FMCG and retail

FMCG industry is among the most dynamic on sustainability topic, going beyond the regulations and relentlessly challenging this topic. They even embark suppliers in this journey. For example, L'Oréal ask its key suppliers to fulfill the CDP questionnaires to continue cooperating (Malpièce, 2018). In order to efficiently address these issues, FMCG rely on internal resources as well as on partnership with focused organization such as Ellen MacArthur foundation or Consumer Goods Forum (Bousquet, 2018). Nevertheless, the focus on sustainability aspects of logistic packaging does not prevail among economic or practical aspects.

Retail chains main expectations regarding logistic packaging are manifold (Swiderski, 2018) & (Badouix, 2018). First and foremost, it is to protect products until shelves replenishment and avoid non quality costs resulting from damaged - therefore not sellable – goods. Damaged products - including originated from logistic packaging failure - can result in food waste which is no more accepted from ethical and economic standpoint. Secondly, it is to allow efficient logistic in order to keep as low as possible workforce handling costs while maximizing in-store product availability and shelf optimization. The cost of transit packaging is insignificant compared to the value of the products it protects and the cost of damage it could generate (Trohay & Lucot, 2018). Yet, it is often considered as a commodity product with a very strong cost focus from purchasers (Bigot, 2018). There is no willingness to pay an extra premium for having a sustainable solution, unlike in private individual behaviors[57]. Therefore, all options have to bring in the first hand economic advantage, environmental benefits being the cherry on the cake (Swiderski, 2018). Consequently, Industrial and supply chain efficiency and cost optimization are the motors for challenging the logistic packaging (Badouix, 2018).

Logistic packaging is currently out of the Extended Producer Responsibility (EPR) scope. To encourage better results and structure a dedicated sector, broadening of EPR to secondary and tertiary packaging is envisaged but under different format, not well defined at this stage (Trohay & Lucot, 2018). However, nobody would welcome such new disguised taxation. Industrial and retail waste and recovery sectors already exist and do not need an extra technocratic layer to properly work (Swiderski, 2018).

Current sustainability focus of industry is mostly on qualitative sourcing and primary packaging optimization. Three main raw materials are under specific attention at Danone: water, milk and plastic. A fully empowered team of 25 purchasers based in Amsterdam is focusing on optimization of these three "cycles". Two circular-economy experts are embedded into this team (Bezati, 2018) and concentrate on recyclability of plastics, incorporation of recycled content and bio-sourced materials. Reduction of primary packaging brings direct and indirect cost benefits through decrease of both material and eco-contribution costs. Secondary and tertiary packaging being excluded of the extended producer responsibility, their optimization only brings material cost benefits. Additionally, the cost ratio primary/secondary packaging is detrimental to the latter, another argument for concentrating on primary packaging optimization (Bezati, 2018). However, it would be untrue to say logistic packaging is

[57] https://www.rse-magazine.com/Les-consommateurs-sont-prets-a-payer-plus-pour-les-produits-des-entreprises-responsables_a2220.html

not in the focus. Indeed industry and retail are focusing on their real sustainability issues like energy consumption (production and temperature driven storage and transportation), freight, food waste and primary packaging. But there is a rising awareness about logistic packaging in terms of quality and costs. If it does not yet trigger concrete action plans in terms of sustainability (Bousquet, 2018) & (Bezati, 2018), FMCG companies are building knowledge resulting in increased awareness, a preamble to action. And Danone wants to play an active role in promoting more sustainable options in all areas – including logistic packaging. As a committed (and powerful) ordering customer, Danone can push suppliers to integrate a certain quantity of recycled content or set-up circular-economy based solutions, as long as the economic equation works well (Bezati, 2018).

5.2 Logistic Packaging CO^2 emissions: a notable absentee

Concentration on other sustainability aspects leads to an incomplete knowledge of logistic packaging GHG footprint. In a consumer good product LCA, both secondary and tertiary packaging are included, but not for their entire footprint unlike primary packaging, but only for shipping and transportation from production site to product packing site and then down the supply chain until end of life (Hugrel & Palluau, 2014). Therefore, its impact on the total product is minimal, as anticipated in interview with (Trohay & Lucot, 2018). In FMCG, there is a big disparity on CO^2 emissions assessment and reduction targets. Logistic packaging is included into scope 3, the indirect emissions[58]. In their declaration obligations, companies must choose for the biggest CO^2 contributors in order to cover 2/3 of their indirect emissions. This includes generally purchasing of raw material, freight and primary packaging. (Malpièce, 2018) never saw logistic packaging in official declaration so far. But regulations are evolving and getting more stringent. Industry will have to adapt sooner or later (Malpièce, 2018). This could be a driver for change of behavior.

Another point of interest encompassing logistic packaging is the convergence of traditional retail and e-commerce. It is driving logistic packaging evolution in a search of innovative solutions fitting both smaller unit loads and mass-retail at the same time These common solutions would allow physical and on-line retail to benefit from economies of scale by serving simultaneously and identically the two channels. This approach is on the agenda of retail. But it is not yet an active topic as more short terms improvements are getting attention of the small team (Swiderski, 2018).

This apparent lack of interest should not overshadow all concrete actions, already in place or up-coming. For example, working on flow optimization delivers substantial benefits. Thus, direct store delivery and cross-docking are delivery patterns allowing efficiency through reduced freight and handling.

Sustainability is often assessed by the packaging industry with easily measurable KPIs like weight reduction, recycled content and recovery rate of post-consumption packaging. This approach totally ignores all gaps between theory and reality and all the undesirable indirect effects. Only a LCA approach can truly evaluate what the impacts are. On upstream side, film producers and converters consider that they are sustainable as they sell 100% recyclable products and they recycle production waste; they do not conduct specific discussion about this topic during selling process: “it is a common understanding

[58] See Note 37

and there is no necessity to underline this aspect during negotiations" (sic) (Moroni, 2018). LCA approach was considered not necessary (Moroni, 2018).

However, LCA presents some limits and speaking about an approach to LCA would be more appropriate (Malpièce, 2018). Technically, a LCA calculates CO^2 footprint of one product manufactured in one production plant and delivered to one point of sales utilizing one defined supply chain. If one of the element varies (type of truck, different distribution center …), the LCA is not valid anymore (Malpièce, 2018). Considering that LCA is rather expensive, generally giving only indications but no solutions, it is conducted on some star products (Trohay & Lucot, 2018) or on very specific topics (Swiderski, 2018), but never systematically on the full range, and never with logistic packaging included.

FMCG companies are generally purchasing their logistic packaging through a tendering process, sometimes with international perimeter (Bigot, 2018) & (Rapp, 2018). They often include in their specifications sustainability criteria regarding sourcing and recyclability. These sustainability criteria have to be met (and proven) to participate to the tender. They can be checked through an audit and document review. However, recyclability criteria depend about where packaging is disposed. This aspect remains partly theoretical. (Rapp, 2018) confirms that end of life or LCA and GHG footprint never come as a priority element during discussions, when this topic is ever mentioned at all, unless introduction of new packaging material could lead to perturbation in waste flows. Only products' performance, availability and cost are at the heart of negotiations (Rapp, 2018). But these aspects can result into an indirect increase of sustainability criteria. A joint work with raw material suppliers is conducted in order to minimize logistic packaging usage (Trohay & Lucot, 2018). Although people safety and cargo stability remain on top of the list, studies are conducted in order to optimize pallet height, reduce interlayers and favor recoverable materials. Re-use is the growing trend for logistic packaging in B2B[59]. It can be done in all the steps of the supply chain. Thus, primary packaging deliveries are more and more done in re-usable logistic packaging. This is the case for example of preforms or bottles delivered in metal pallet-boxes or shuttle corrugated boxes (Trohay & Lucot, 2018). It is also expending in store deliveries. Use of Roll-cage trolleys or reusable foldable boxes in fruits and vegetables are taking greater importance (Swiderski, 2018). However, utilization of re-usable hoods for pallet or trolley was not successful. Many hoods were lost or damaged. Management of re-usable packaging may be sometimes difficult. Re-usable packaging development contributes to reducing waste at each step of the supply chain, an important aspect in FMCG. Indeed, specific focus is given to waste management as it has become more and more important in quantity within all industrial and commercial premises. Waste collection and recycling/recovery are intimately linked to sustainability as they constitute the only way for decoupling growth from non-renewable resource consumption.

5.3 Logistic Packaging waste management and recycling: the Achilles heel

In all industrial premises, a first and simple focus is made on raw material efficiency. Any production process generates manufacturing scrap. It can be either disposed or recovered directly in production. This scheme is widely used in corrugated as recycled material incorporation is embedded into production process. But for plastic extrusion, it cannot be done without slight adaptation of production tool. An

[59] B2B: Business-to-Business = commercial activities among professionals.

example is specific capital expenditure of EUR 2m made in a stretch film facility in order to reintegrate production waste into raw material flow. Thanks to this, virgin raw material has been spared as well as all transport costs and emissions. A payback of 6 to 7 years could be achieved, a long time for financial standards (Moroni, 2018). This demonstrated that common sense and sustainability could sometimes take precedence over pure economics.

But waste cannot always be recovered in such a short closed loop. If final waste is a cost, recoverable waste can generate revenues. This motivates setting-up of specific sorting processes and targets. Thus, for example, General Mills has set targets for production facilities of 0% waste in landfill and 10% in energy recovery in order to gear maximum of waste towards recycling. This ambitious target is sometimes difficult to achieve as waste collection can be unsuitable, especially in remote production sites (Trohay & Lucot, 2018). Waste flow to the compactor is under the responsibility of operations (Singier, 2017). It is not unusual to observe that this action is not executed timely and efficiently, resulting into bin spill-over (picture 9). The different nature of products (boxes, films or strapping) leads to volume under-optimization in collection bins. As plastic films are hardly compressible they quickly come back to initial volume and fell of waste bins. This could divert packaging films from recycling to common waste. This issue is partially covered with waste compactors but all upstream flows suffer from this characteristic.

In-store waste sorting has many constraints. Space and waste evacuation can be critical - especially in high density urban areas. Store waste can be divided into 4 categories: bio-waste, corrugated, plastics and all the rest. Bio-waste is coming from non-packed food waste un-proper for consumption. It is allocated to methanisation to produce fuel used in delivery fleet. This is a good example of a circular application recovering waste and sparing fossil-fuel. However, bio-degradable packaging should not be added to bio-waste methanisation process as it deteriorates significantly yields (Swiderski, 2018). Shelving products generates secondary and tertiary waste (generally corrugated and films) inside a shopping area. It can disturb customer experience as it occurs during opening hours. Waste collation can be done on a wooden pallet or re-used box-pallet (pictures 7 & 8) in order to later be moved to waste processing areas in the back-shop. There, corrugated are generally baled using a specific machine and plastics (all stretch and shrink plastic films) are gathered into large bags. All the rest goes with common waste. Cartons and plastics are removed every day either by waste trucks or, for smaller shops, by temperature controlled delivery truck in a reverse logistic scheme and sent back to warehouse. The valued materials (cartons) are then “credited” to the store waste management costs. Bio-waste benefit from a specific collection while common waste collection depends on classification of the site: either economic activity waste or household waste (Swiderski, 2018) & Monoprix Levallois.

Industrial and commercial waste is already pre-sorted on site. It is either compacted into a container or directly baled or remain in bulk before being transported to Waste Collector site. After weighting, compacted waste containers or bulk are emptied into an open area. Waste is sorted mechanically with cranes and manually in order to remove polluting elements (pictures 17, 19, 22, 23, 24). Then, sorted waste is feeding baling machines with homogeneous quality materials (picture 11). New bales of homogeneous quality are made for corrugated and plastic films. These bales are the trading unit for the recycling raw material market (pictures 20, 21, 25, 26, 27). When received directly in bales (corrugated

or plastics - picture 16) and after visual inspection, it joins the recycling feedstock – or the energy recovery feedstock for downgraded lots.

Each quality category obtains a grade (from low to high quality) from which recyclers purchasing price will depend; top grades get the better prices. Corrugated quality grades are very well defined (Groulez, 2018). According to norm EN643[60], corrugated is divided into five families, from 1.01 (poor quality) to 1.05 (top quality). Corrugated coming from supermarket is categorized 1.04, meaning very good quality. Market for good quality is fairly big as it is a key raw material for corrugated manufacturers. Nevertheless, presence of adhesive tape can be detrimental to recycling quality. Field observation allowed noticing that Picard-Surgelés employees for example remove tape from boxes in order to generate qualitative feedstock. Corrugated cores for stretch films and adhesive tapes can be recycled but at a lower grade than boxes because they contain glues and resin to strengthen their mechanical characteristics (Groulez, 2018).

For plastics, if criteria are not as structured, they are well-known and shared among professionals (Groulez, 2018). The first formalized specifications were issued by the (Plastic Recyclers of Euope (PRE), 2018)[61] in November 2017. They describe the material and the accepted external interfering elements in quality and quantity. Main pollutions are of two origins. Firstly, labels are generally glued on two faces (length and width) to ensure they are always visible, whichever way of the pallet. Indeed, pallet can be stored in racks with facing length and width, on the platforms shipping/receiving deck or inside trucks pallets can be stuck together (Trohay & Lucot, 2018) (picture 5). Abundance of labels repeating the same information degrades the quality of film feedstock for recycling (Groulez, 2018) & (Plastic Recyclers of Euope (PRE), 2018) (picture 24). Secondly, colored films are also downgrading quality. (Swiderski, 2018) mentions a difficult negotiation conducted between Carrefour and Coca-Cola to switch Coke's highly distinctive red shrink film around pallets to a white or natural film. In this case, the sustainability argument had weight in the balance of power between retailer and Brand Owner but it took some time to be accepted and applied. This question can also be addressed with water bottles pallets covered with blue shrink film (picture 5). It seems that all battles have not been fought or won. Even with retail Private Labels, no strict specification in terms of tertiary packaging regarding quantity or quality is required. Some indications are given but not imposed, allowing standardization of packaging process within subcontractors (Swiderski, 2018).

Indeed, quality of recycling feedstock is a major determinant of value. Therefore, ensuring the best recoverable material feedstock is a shared target for industry, retail and waste management. It directly influences the valuation of their waste, i.e. price at which waste collector purchase waste to waste holder. China waste ban (Golla, 2018) emphasized this aspect. By creating a sharp drop in waste demand, feedstock prices plummeted, challenging the balance between waste valuation as a revenue and waste flow separation as a cost. If waste sorting does not bring value, then additional costs to achieve good quality feedstock are not justified – only legal requirement imposes to maintain sorting (Swiderski, 2018). For example, plastic feedstock that could be valued at 50 €/t before is now costing 150€/t. 200€/t difference on the economic equation (Bezati, 2018). But this ban also created a recycling capacity surplus

[60] See appendix 8.5
[61] See appendix 8.6

locally. Ban eases and only concerns low quality feedstock. High quality feedstocks can still be exported to China. To enforce this ban, Chinese customs were sent to the port of Rotterdam to check quality of the waste feedstock before shipment (Groulez, 2018). Important rejection rate created an overstock of waste, leading to immediate necessity of storage. Since few recycling opportunities could be identified, significant portion goes now to energy recovery, a far less rewarding option (Groulez, 2018).

From the industrial and retail standpoint; waste management is fully delegated to specialized third-parties. Little control is operated by waste holders. They obtain from waste management companies the needed certificate about waste collected (quantity and quality) and its further destination (landfill, energy recovery or recycling) (Swiderski, 2018) & (Trohay & Lucot, 2018) & (Singier, 2017). But neither industrials nor retailers know exactly which recovery channel is used for their packaging waste. Waste management companies also keep a soft focus on the downstream allocation (Trohay & Lucot, 2018). It is a significant part of their profitability: recycling raw materials can be more or less well valued depending on demand but also about quality of supply. China ban had a collateral effect. Waste holders started to be suspicious about waste management companies' behaviors and profits when they realized that significant portion of waste was going to China for recovery (Swiderski, 2018).

Interviews and field observations confirmed that many improvement actions are undertaken by all players of the value chain, from sourcing to recovery. Nevertheless, low GHG impacts of logistic packaging make it less into focus than raw material, freight or temperature control. But there are still avenues for progress in this area.

6 Recommendations & Conclusion

Integrating the principle of circular economy with a viable economic answer seems the only path to the make a real breakthrough. It has to be simple and profitable to draw attention and interest as most of the stakeholders are concentrating on issues far more contributing to GHG emissions than logistic packaging. Solutions for a short-term impact are here but not yet systematic and still under-optimized. They need for a strong push to upscale and enlarge these solutions and make them become mainstream and retained by all players along the value chain, as advocates Karl Falkenberg, Director General for Environment at the European Commission (Bisgaard & Tuck, 2014).

In the logistic packaging market where all actors have the willingness to achieve sustainability but not the willingness to pay for it, building a competitive advantage can be achieved through differentiating innovation. Nevertheless, incremental innovation and operational excellence, although not bringing competitive advantage, can still support business development and profitable growth (Porter & Heppelmann, 2014). FMCG and retail are in a frantic race towards sustainability but cannot embrace all topics. Packaging distributor, with its specific positioning between packaging producers and users, can support this race on behalf of the consumer goods industry by appropriating this subject.

As a mirror to the key findings, let's investigate some possible answers or improvement ideas for a packaging distributor eager to grow its business and attract customers while contributing to a more sustainable world.

There are many hurdles to overcome to develop a more sustainable approach for logistic packaging. Not all are located inside the FMCG industry or in retail but could lie in any player of the value chain.

6.1 Sustainability exemplarity

As any other company, a packaging distributor willing to promote sustainability in its product, service and solution offer needs not to do it solely at customers and prospects. It has also to walk the talk and apply internally a global and ambitious CSR strategy. Focusing on carbon footprint, this would need an action plan addressing enhanced sustainability internally (operations) and externally (sourcing and offer to the market) in order to gain legitimacy and trust.

In the field of operations, B-to-B distribution is articulated around IT systems, warehouses and fleet of handling material, sales representative cars and delivery trucks. Thus, energy consumption, be it electricity or fuel, is an important variable cost driver. This cost base will mechanically and inexorably increase until 2050 due to Contribution Eco-Energie[62]. In order to foster the switch toward lower CO^2 emission infrastructures, a carbon pricing element could be included in the investment payback calculation (Berruti, Giorgi, & Morgan, 2017). This would not be just an artificial criterion but a true driver as internal carbon pricing is the anticipation of contribution evolution; because investments are meant to last over time, this anticipation can generate future financial benefits on top of environmental and business ones.

[62] See appendix 8.9

This conversion can be organized progressively with renewal investments. It can also benefit from tax incentive or cost reduction implied by reduction granted for special schemes with a payback on energy bill (Denuit, 2018) & (Berruti, Giorgi, & Morgan, 2017). As examples, delivery trucks using GNV rather than Diesel could be favored, avoiding business interruption in case of traffic restriction and making substantial economy on fuel price and consumption[63]. Company car policy regarding diesel, gas or hybrid could also be adjusted with the same motives. Energy for warehouse heating and handling material battery recharge could be supplied by renewable energy either purchased from a provider with a special contract or directly produced on site with solar panels or windmills. IT hardware could also be hosted in external or internal "green" server farms. All these actions would additionally influence the employees' sensitivity to sustainability.

6.2 Sustainable logistic packaging: a business approach

Looking at its environment, a packaging distributor could easily take ownership of the logistic packaging sustainability topic. It would relieve FMCG industrial, 3PL and retailers from this subject and packaging distributor could act as a global solution provider offering a "peace of mind" approach. Externalization of the logistic packaging function could act as a pain reliever and sustainability gain creator[64].

Packaging distributor is at cross-road between packaging manufacturers, FMCG industry and retailers. It does not rely on a single industry (pallet / corrugated / plastic packaging) but can created and integrate innovative solutions from various suppliers / partners. It is uniquely positioned to build a tailor made offer to the market. Sustainability could be a very distinctive feature to add to current service and product offer, which could grant a distinctive advantage versus competition.

The value proposition should be three-fold and articulated around products, services and solutions. All its components should bring economic benefits, in its widest sense to exit the price discussion. Global value delivered by logistic packaging can help substantialize sustainability and make it acceptable and accepted by customers.

The product offer must integrate multiple parameters. It has to include recyclable materials contributing to circular economy through recovery and recycling. The recyclability aspect should be assessed with current infrastructures. Given the nature of logistic packaging materials, they would easily fit into the criteria presented in appendices 8.5 and 8.6. For France specifically, it would participate to creating a bigger flow of qualitative materials towards recycling infrastructures, supporting the needed improvement of sector's profitability.

Products must not only be recyclable but must include as well recycled content. This recycled content has to come from post-consumption recycled raw materials. Only this source contributes to circular economy by creating business opportunities for raw renewable materials (RRM), unlike production scrap reintegration. This can be the case for almost all products.

[63] In addition, GNV vehicles can benefit from free car registration document
[64] Pain reliever & gain creator are part of Strategyzer Business Model & Value Proposition Canvases.

Bio-sourced materials should also be included in the offer. Even if price still remains high and often uncompetitive, it should be proposed as an alternative to virgin or recycled source. Few customers might want this kind of products. Promoting this source of product will also contribute to reach higher volumes and help decrease prices.

In the area of machines, specific focus on energy consumption shall be given. Energy efficient machine range should be proposed in order for companies deploying ISO50000 to find packaging machines suiting their requirements.

Materials and machines contributing to the circular economy scheme should also be added. Articles relating to waste management such as big-bags, waste containers, baling machines, shredders… should supplement the product offer in order to support customers truly targeting a global environmental achievement.

A packaging distributor cannot suppress from its range products considered as non-sustainable on the grounds that it is promoting a "green" offer. The two offers have to coexist simultaneously as not all customer-base is interested in purchasing sustainable products. For each product proposed, a sustainable alternative must be available.

The service offer is complementing and enriching the product offer. Its objective is to support customers or prospects achieving their sustainability targets. Various services can be proposed:

- Packaging material support: help selecting products totally compatible with recycling requirements. Packaging distributor can contribute through advice and consulting approach to reducing or eradicating non-compliant materials (tinted films, large labels) that could contaminate a homogeneous and qualitative recycling feedstock.
- Packaging Eco-Design: Eco-design is an interesting feature of incremental innovation: existing solutions to be improved and extended. Eco-design would better anchor the customer connection by building a relationship based on partnership rather than customer/supplier. Box and pallet optimization (also known as cube optimization) would help maximizing the product/packaging ratio. It would mechanically result in freight efficiency by reducing CO^2 emissions (Bisgaard & Tuck, 2014). This area is as of now covered either by box manufacturers or by some freight forwarders. Packaging distributor could rely through sub-contracting on already existing capacity or either builds its own. A mixture of both can be envisaged: start with sub-contracting and when enough projects allow reaching a critical mass, build the internal capability.
- Packaging environmental impact: measure and supply customers and prospects with GHG emission estimation either on a selection of products or on specific products. This can be useful for customers willing to integrate this element into their "scope 3" declaration[65]. It can also simply allow selection of least impacting product. This would grant packaging distributor a mean to perform benchmark

[65] See note 37

about the “greenest” offer, integrating all the product life cycle. It can also support starting discussions with suppliers about improvement plans.

- Packaging communication toolkits: in connection to eco-design, prepare ready-to-use communication sets about logistic packaging optimization and associated CO^2 impacts. It can support the brand image towards more sustainability in order to inform consumers and eventually help conquer or retain customers. Since use of environmental claim about packaging is quite restrictive, this communication would be limited to in-store or website communication. Weight and/or waste reduction and freight optimization could be claimed and understood by consumers[66]: people can better visualized and understand an argument of “–X trucks on the road” rather than “–Y tons of CO^2 emissions” or “–Z tons of virgin plastic saved”[67].
- Carbon Offset: When looking at CO^2 emissions directly linked to logistic packaging life-cycle (from production to end-of-life), carbon offset could also be proposed. Carbon compensation (or carbon offset) can be considered as an easy way to buy “clean” consciousness by offsetting the CO^2 emissions through financing of an accredited project. But does it drive behavior change toward true sustainability? No evidence is made as this system allows keeping current non-sustainable behaviors (Fragnière, 2009). It surely can be envisaged as a first step in the direction towards sustainability, but it cannot entirely be considered as a final or long term solution. However, when no carbon-free alternative is available and applicable within a short period of time and at an economical acceptable level, carbon offset is the only way to transform a non-sustainable option into a (more) sustainable one. This can be the case, among others, for plastics (until 100% bio-plastic gets to an economical viable level) or transport (until clean energy for mobility has been generalized). It can be proposed as a service to companies willing to offset their CO^2 emissions together with a sustainable product offer. In order to be able to make a “Green Offer”, the companies should know the carbon footprint of each of its products. Only an approach by main family can be seriously envisaged (Malpièce, 2018) because detailed CO^2 emissions calculation through Life Cycle Assessment is complex and costly.
- Packaging machines recovery: machines are durable goods that can have several lives. Packaging distributor, in its quality of machine distributor, can propose a machine recovery service. Machines could be retrofitted and sold as used machines or be used for spare parts or supply specifics recovery and recycling channels.

Other services could be added along the way, such as packaging reverse logistic.

An option to get stakeholders’ interest for a packaging distributor is to promote not only standalone sustainable products and services but also to mix them in a solution.

The solution offer: by combining products and services together and integrating life-cycle thinking, an enhanced global solution offer can be proposed in a “peace of mind” approach. In such case, customers would fully rely on packaging distributor to supply a turnkey sustainable solution.

[66] Common allegation about waste decrease quantity and truck traffic reduction
[67] http://reduction.ecoemballages.fr/catalogue/

Today, in its commercial activity with large FMCG and retail organizations, packaging distributor mainly interacts with packaging purchasers, sometimes packaging users. But it does not have contact to upper level where the true players of change are. To promote a solution based approach, packaging distributor needs to address all the stakeholders with a holistic approach and adjusting the pitch to the audience:

1- Sustainable director / top management: for strategic sustainability discussions
2- Middle management (Purchasing and Sustainability): for tactical approach in selection process
3- Purchaser: operational negotiations about products

The global sustainable solution cannot be chosen without involvement and approval of customers' sustainability managers. The sales cycle can be quite long and involve many loops for specification definitions and price negotiation.

As previously seen (3.3, Re-duce), the most sustainable packaging is the one that does not exist. Although it is not possible in the current status quo, packaging distributor could contribute to giving the customer the feeling that packaging never existed. This ultimate solution would totally relieve customers from packaging burden through an offer of a "packaging-as-a-service" solution (PAAS). In such model, packaging distributor would recover packaging in the same quantity as what was delivered (Porter & Heppelmann, 2014). This can be achieved by relying on re-usable packaging or by removing used packaging or packaging waste. A reverse logistic scheme in coordination with various actors (waste management and supply chain) must be set-up to collect empty packaging after use. This solution has to be thoroughly studied, relevant KPIs accurately defined and offer precisely priced in order to ensure profitability while contributing to an enhanced customer experience.

This "green" value proposition should include all the scope of sustainability products, services and solutions in order to remain the one-stop-shop distributor for the customers. Nevertheless, it should entirely be embedded in the global offer, together with traditional range of products – even "unsustainable" ones. There should be the possibility to be presented separately in a dedicated brochure, catalogue or webpage. But it can as well be presented together with other products and services but with a clear identification, with a specific logo for example.

6.3 Sustainable logistic packaging: the needed competences

The logistical challenge induced by circular economy could only be tackled through a global approach. Being recognized as a preferred interlocutor able to deliver this global offer implies to be and stay informed, grow knowledge and develop expertise in the field of sustainability.

Packaging manufacturers as well as FMCG and retail have developed competence around sustainability, circular economy and recycling. Packaging distributor is lagging behind and has to close the gap to sustainability expertise. Even if this sustainability has not truly made its way to secondary/tertiary packaging purchasers within FMCG and retail, it is just a matter of time. Today, basic sustainability aspects are included into packaging bidding specifications (Bigot, 2018). One day will come when this topic will also be tackled during negotiation as a key decision-making driver. Additionally, "green" packaging is a complex matter where there are no certainties (what is true now can be false tomorrow and vice-versa) and many counter-intuitive situation (e.g bio-plastics also have a negative environmental

impact compared to oil based plastics because of chemicals used in agriculture to grow bio-plastic source (Remy, 2014)), packaging distributor needs to start building this competence now. It will be too late to start when customers will challenge this subject.

The needed competences to be developed by key resources would be:

- Packaging materials life cycle and associated GHG emissions (production, transport, usage and end of life)
- Recycling constraints and best recovery usage
- Recycled product benefits compared to virgin products
- Legal framework

These competences can be obtained either by training of internal resources or by recruiting outside specific profiles. Building competence would allow starting customers' relationship based on sustainability topic through key activities like meeting with suppliers' sustainability directors and managers, attend international conferences or contribute to specific projects and working groups. This will give packaging distributor exposure and grow awareness about market expectations and trends. Having people trained and sensitive to the sustainability concept is necessary to speak, advocate and convince customers or prospects. Such experts could support key-account salesmen at their customers when the need arises.

Based on internal competence, identification of key partners could allow defining the suppliers portfolio based on sustainability criteria such as environmental and sustainability certifications, adhesion to UN programs such as Global Compact or Sustainable Development Goals (SDGs). Together with identified key partners, packaging distributor would build the precise value proposition through products and service selection process.

Building internal competence on box optimization can be achieved through packaging engineers trained in palletization plans matching all constraints and regulations while delivering cost-efficient solutions.

This strategical approach should support the inception of a competitive advantage and contribute to change paradigm on sustainable logistic packaging. Given the complexity and constant evolution of this topic, mastering this approach and offering an adequate value proposition could become a true competitive advantage that customer would value and that would be difficult to bridge for competition. The keeping the edge implies to constantly and pro-actively rework the value proposition by associating innovative product and services.

6.4 Sustainable logistic packaging: the needed innovation

Regarding incremental innovation, it is necessary to strengthen the product, service and solution offer, bring value to the customer and eventually include some differentiation from competition. But it would not characterize a competitive advantage. It would anyhow be useful in the short term as it will optimize and streamline the model. It will as well contribute to an increased awareness of packaging distributor sustainability offer. But it will at one point in time unavoidably reach an asymptote and bring little or

even no further benefit. Then, truly breakthrough innovative solutions resulting from a life-cycle holistic thinking should take over to accelerate the pace of conversion.

Doing business as usual is no longer an option in order to gain or maintain a leadership position. Innovation is the accelerator that any organization needs in order to differentiate from competition and gain interest from the market. But innovation occurs everywhere and screening the market together with the support of packaging manufacturers is mandatory; it may deem necessary to stay informed through an efficient tech watch. In the field of tech watch, Internet of things and RFID are to be monitored as they allow connectivity, dialogue and geo-localization for indoor and outdoor applications.

The physical internet project shed light upon a closed loop and connected system for logistic packaging. Becoming durable and re-usable, logistic packaging cost would rise. It would therefore be considered more as an asset investment (to be purchased or rented) than a disposable item. This automatically raises the question of ownership. Such re-usable logistical packaging would change the current pattern of purchase and dispose. It could either stays property of manufacturer, or purchased by packaging user (industry, retail or logistic) or this service would be contracted to pooling specialist (like pallet or foldable boxes today[68]. Packaging distribution runs the risk to be excluded from some segments of the market and lose part of its business if not adapting to a new paradigm. Clearly, with emergence of connected objects, distribution runs the risk to be disintermediated by manufacturers (Porter & Heppelmann, 2014). Even if PI project does not materialize fully, it is echoing the trend towards more reusable packaging moving in a closed loop allowing repair and recycling. It started with pallets. It is now expanding to roll-cage trolleys and foldable boxes for fruits and vegetables. It will surely expand futher.

6.5 Conclusion

Disposable packaging will not disappear. But it will surely reduce impacted by virgin resource scarcity and price volatility and development of re-usable packaging. As massive users of logistic packaging, FMCG and retail are monitoring market trends. They will also experiment new schemes, pushed by e-commerce growth changing logistics and packaging and by GHG emissions pricing. Packaging distributor should include these trends in its strategic thinking to be able to counteract the upcoming adverse effects and contribute to a more sustainable logistic packaging through an appropriate offer of alternative products and innovative services and solutions.

[68] See Chep; https://www.chep.com/fr/en/consumer-goods

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8 Appendixes

8.1 Market Size

Market Size of Logistic Packaging for FMCG according to Smithers Pira[69]

2016								
	World	Packed CG	FMCG	Food	Non Food	Europe	France	France FMCG
Pallets	37.5	29.5	17.9	13.9	4.0	12.3	1.7	**0.8**
Strapping and ancillary	12.4	-	-	-	-	4.1	-	**-**
Stretch Wrap	7.0	5.5	3.4	2.6	0.8	2.3	0.3	**0.1**
Corrugated Boards	7.6	6.3	3.9	3.0	0.9	2.5	0.3	**0.2**
TOTAL	64.5	41.2	25.2	19.6	5.6	21.2	2.2	**1.1**
in % of World Total		63.9%	39.1%	30.4%	8.7%	32.9%	3.5%	**1.7%**

2022								
	World	CG	FMCG	Food	non food	Europe	France	France FMCG
Pallets	44.47	33.26	20.44	15.26	5.18	13.48	2.61	**1.20**
Strapping and ancillary	14.28	-	-	-	-	4.47	-	**-**
Stretch Wrap	9.40	7.05	4.34	3.25	1.08	2.85	0.34	**0.16**
Corrugated Boards	9.52	7.57	4.68	3.51	1.18	2.88	0.34	**0.17**
TOTAL	77.67	47.89	29.46	22.02	7.44	23.67	3.30	**1.53**
in % of World Total		61.7%	37.9%	28.3%	9.6%	30.5%	4.2%	**2.0%**

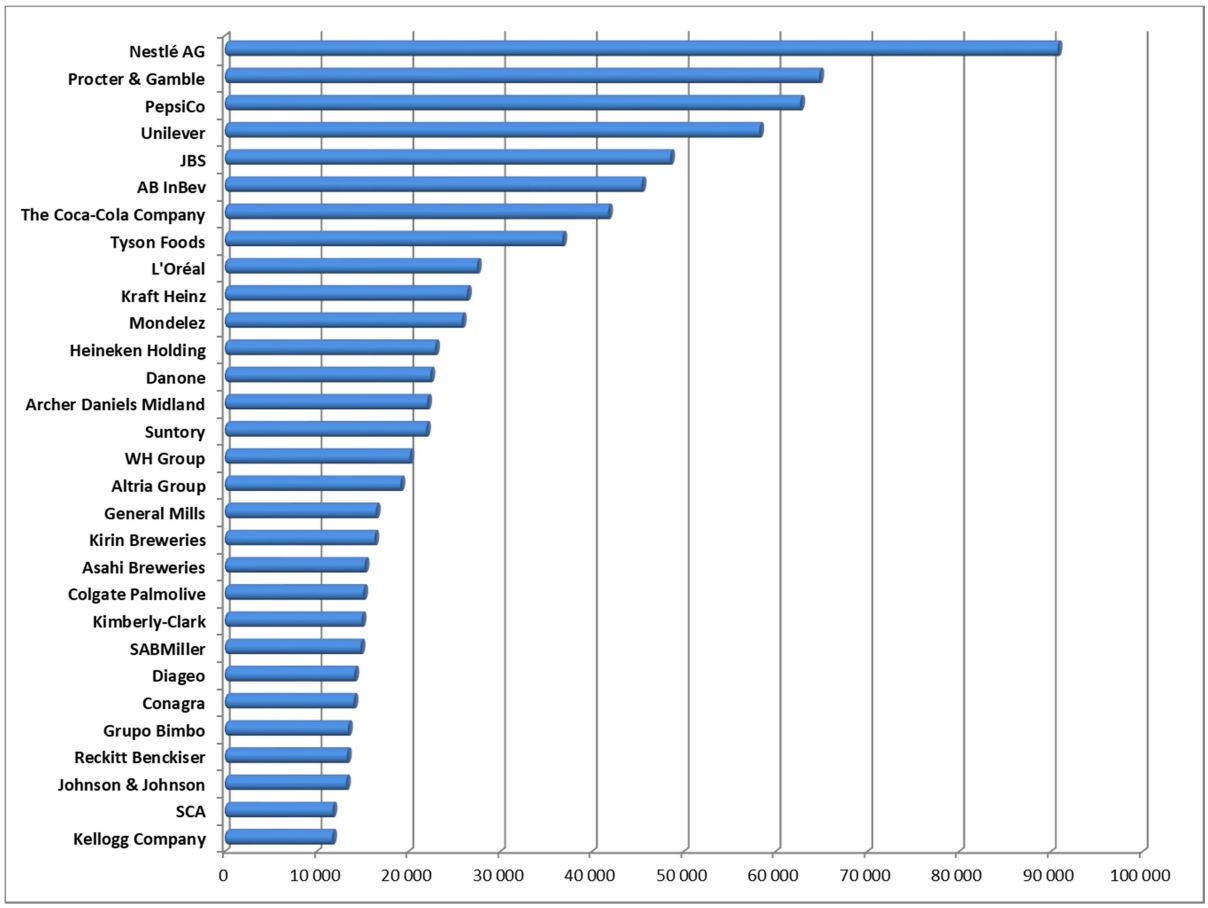
CG = consumer goods

[69] « the future of protective and transit packaging to 2022" by Robert C Brothers / Smithers-Pira 2017 pages 93

8.2 Top 30 FMCG companies

Ranking of top worldwide FMCG companies by turn-over[70]

(Excluding tobacco companies as they do not follow FMCG model in France)



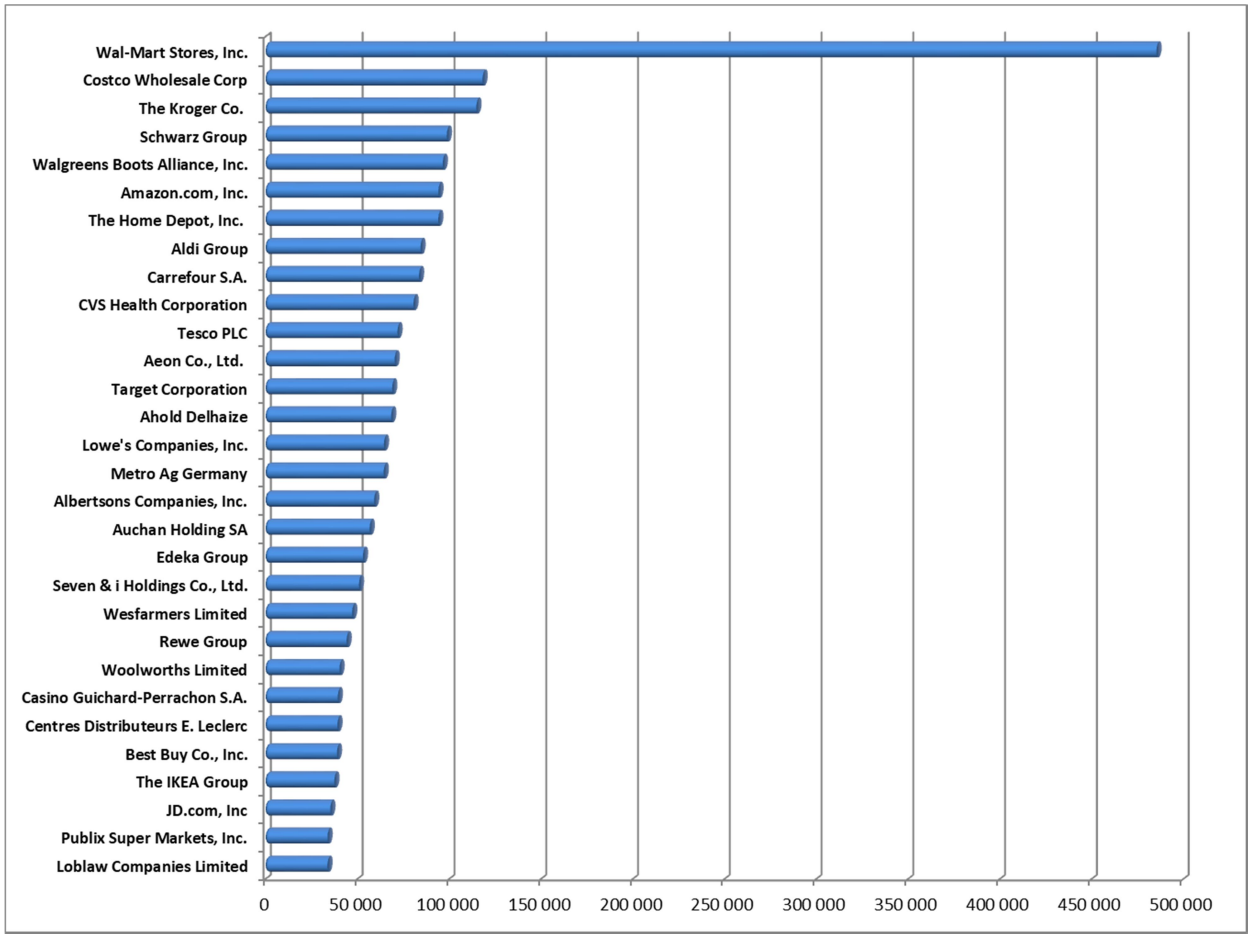
Top worldwide brands per FMCG company:

#1 **Nestlé**: Nescafé, Nesquick, Cheerios, Maggi, Buitoni, Herta for food - Perrier, Contrex for waters
#2 **Procter & Gamble**: Head & Shoulders, Pampers, Gillette for personal care – Ariel, Dash and Swiffer for home care
#4 **Unilever**: Alsa, Amora or Knorr for food - Dove, Signal, Rexona for Personal care – Cif, Omo, Persil, Domestos for home care
#9 **L'Oréal**: L'Oréal, Garnier, Maybelline
#10 **Kraft-Heinz**: Heinz ketchup and dressings, Benedicta
#11 **Mondelez**: LU, Milka, Cadbury …
#13 **Danone**: Activia, Actimel, Danette, Gervais for dairy and Evian, Badoit, Volvic for waters
#18: **General Mills**: Yoplait, Häagen-Dasz, Green Giant, Old el Paso, Cheerios

[70] lebensmittelzeitung.net by Statista, 09/2017

8.3 Top 30 Retail Distribution companies

Ranking of top worldwide Retail companies by turn-over[71]



[71] Global Resource of Retailing 2018, Deloitte

8.4 Pallets

Pallet has become the standard for logistics in the 1970's when growth of consumption, need for transportation between production sites and purchasing locations. Over almost 50 years, manufacturers efficiently optimized production, use and disposal of pallets.

Although associated to Packaging, pallet is a bit hybrid because pallet manufacturer are not into packaging industry but limber industry.

Pallets can be made of wood, metal or plastic.

In France, wooden pallets (new & refurbished) represent 95% of the market – the reminder being split between Metal and Plastic. [72]

- Comparative table of pallets (dimension 1200x800)[73]

	Wood	Wood refurbished	Metal	Plastic
# of use	28	25		
Weight in kg	26	26	36	13-18
Price (HT) / pallet	From 18€ to 25€	15€	From 200€ to 230€	From 40€ to 90€

Wooden pallet industry has long ago organized to meet productivity requirements to fulfill price attractiveness as it served very competitive transportation sector. Thus, all this structuration supports pallet industry in meeting the current sustainability criteria:

- Sustainable sourcing
- Re-use / repair
- Recycle

Pallet industry is centered around 3 major actors, all contributing to making this industry well organized

- Pallet manufacturers
- Pallet rental companies
- Pallet refurbishment companies

In terms of sourcing, pallet industry relies on mainly two options, both being sustainable. It can be either wood coming from sustainably managed forest (FSC / PEFC) or it can be wood coming from tree-thinning (that would have been either discarded or used as wood fuel).

Regarding re-use and repair, the industry organized itself and many companies are disseminated on the territory.

[72] Site internet palettes
[73] http://rotomshop.fr/palettes.html
https://stockage.ooreka.fr/comprendre/palette-stockage

Another lever used by pallet industry is to "relocate" pallets in order to avoid unnecessary transportation and thus contributing to fewer GHG emissions. This system is working at European level as all pallets standard have been harmonized across the EU[74]. Pallets are managed in pool and are re-addressed by freight forwarding companies to customers from the closest storage location. It is an evolution of the returnable packaging. The results are illustrated by the relatively low distance covered by pallets: 41% of new pallets and 55% of used pallets are sold and 59% of second-hand pallets are recovered within 100km[75].

Pallet industry is proud to announce a negative carbon footprint[76]. This is mainly the result of wood being a carbon sequestration product but also of an industry having organized itself around the basics of sustainability: re-use / repair / recycle. All along the supply chain, pallets a sorted by industrials, retailers and freight forwarders in order to keep in use good quality pallets. Broken and damaged pallets are then oriented to refurbishment companies. These companies have collected 106 million pallets in France in 2015 and have put pack on the market 94 million, the remaining 12 million have be addressed to recycling/recovery[77]. The cost and environmental impact of pallet repair can be considered negligible with more than 200 companies covering the national territory: this means an average of 2 per department.

Humidity included in wooden pallets, which can result from external storage for example, can increase by 9kg its normal weight of 26kg, thus increasing gross cargo weight and influencing negatively fuel consumption during transportation. Knowing that a trailer truck can contain up to 33 euro pallets, this in an increase of 300kg of total cargo (roughly half a pallet, i.e. +1.5%) but could result in an increase of more than 5 tons on a full truck of pallets (case for pallet recovery). This aspect does not concern metal or plastic pallets which are insensitive to this phenomenon.

Regarding end of life (because pallets cannot be repaired and re-used indefinitely, it is estimated that pallets last around 8 years with a frequency of 3.5 rotations per year[78]), Waste management or pallet refurbishment companies are re-addressing old pallets to specific transformation companies. Decommissioned pallets are grinded into wood chips used for industrial heating (80%) and for construction (20% with wooden walls and timber frames & structures) s well as composting for agriculture. This resource is estimated at 0.8 million tons per year[79] is substituting either construction materials or fossil energy, big providers of waste and CO^2 emissions[80].

This is a good example of sustainability being cost efficient that could be a source of inspiration for other packaging industries.

[74] http://www.palettes-europe.com/palette_epal-eur.html
[75] Etude Structurelle ; palettes, caisses-palettes, emballages industriels, emballages légers », données 2015, Institut d'informations et de Conjonctures Professionnelles. 23/5/2017. Page 26.
[76] « la palette bois enfonce le clou », Sypal (Syndicat des fabricants de palettes), page 11
[77] Etude Structurelle ; palettes, caisses-palettes, emballages industriels, emballages légers », données 2015, Institut d'informations et de Conjonctures Professionnelles. 23/5/2017. Page 20.
[78] « la palette bois enfonce le clou », Sypal (Syndicat des fabricants de palettes), page 8
[79] Sortie de Statut de Déchet Broyats de d'Emballages en bois, Eco-bois, JP.Tachet & L. de Reboul, 03/2015
[80] http://www.sita.fr/bois-et-palettes/

Plastic pallets are also developing (heavy-duty) made of recycled plastics: Intermarché purchased end of 2016 260,000 plastic (HDPE = high density polyethylene) pallets for their downstream supply-chain (warehouse to store): this evolution was made possible thanks to cost savings compared to wooden pallets resulting from lower breakage rate despite intensive use (50 rotations per year), lower weight (12kg vs 26kg, positive for reverse logistic), optimized transported cargo with higher useful load and pallet which is 70% recycled plastic caps[81] and 100% recyclable: another step towards sustainable transit packaging. [82] This solution also echoes to the growing need of distribution automation[83] : with dimensional and weight stability, pallets could integrate more easily automated processes comprising conveyor belts, palletizers and racks.

Metal pallets are more present, especially in retail, under the form of trolleys often used to deliver small quantities in small retail shops.

[81] Emballagesmagazine.com, 23/5/2016
[82] http://www.strategieslogistique.com/Intermarche-s-equipe-de-250-000,6400
[83] « the future of protective and transit packaging to 2022" by Robert C Brothers / Smithers-Pira 2017 pages 12

8.5 Corrugated

Norm EU 643 List of European standard types waste paper

Group 1 - Ordinary grades

1.01 - Mixed paper and board, unsorted, but unusable materials removed
A mixture of various grades of paper and board, without restriction on short fibre content.

1.02 - Mixed papers and board (sorted)
A mixture of various qualities of paper and board, containing a maximum of 40% of newspapers and magazines.

1.03 - Grey board
Printed and unprinted white lined and unlined grey board or mixed board, free from corrugated material.

1.04 - Supermarket corrugated paper and board
Used paper and board packaging, containing a minimum of 70% of corrugated board, the rest being solid board and wrapping papers.

1.05 - Old corrugated containers
Used boxes and sheets of corrugated board of various qualities.

8.6 Plastics

Plastics are one of the most complex items when it comes to sourcing, using, sorting and recycling.

There are two mains categories of plastics: thermoplastics (listed below) which are all recyclable and thermosetting which are not recyclable as the transformation experienced is not reversible[84].

First, there are 7 different thermoplastics as shown in table below[85]:

Logo	Abbreviation & Name	Prime usage	Recycled usage	Logistic Packaging application
	PET / PETE	Water bottles Shampoo bottles	Water bottles	Strapping
	HDPE	Milk bottles Shampoo bottles	Chemical bottles, Boxes Waste bags	Boxes Pallets
	V / PVC	Food boxes	Outdoor furniture	Corner protection
	LDPE Low Density Poly Ethylene	Waste bags Plastic bags	Mailers Waste bags	Stretch & shrink films
	PP Polypropylene	Food boxes Plastic tableware	Brooms & brushes Trays Ice-scrapers	Strapping
	PS Polystyrene	Food boxes Plastic tableware	Hangers Flower pots	N/A
	Others Mostly Nylon and Acrylic	-	-	N/A

The fact that these family numbers are represented into the Möbius circle means that they are all recyclable.

[84] https://ecoinfo.cnrs.fr/2016/05/10/recyclage-des-plastiques/
[85] https://lemballageecologique.com/2011/06/30/les-symboles-du-recyclage-sur-les-emballages-plastiques/
https://envi2bio.com/2013/09/15/tri-selectif-recyclage/#jp-carousel-7164
http://instiks.com/pin/2796/

Film bales specification for a qualitative recycling feedstock (Plastic Recyclers Europe – November 2017)

RecyClass™
PLASTICS RECYCLERS EUROPE

PE Transparent Natural Flexible film

	YES Full compatibility Materials that passed the testing protocols with no negative impact OR materials that have not been tested (yet), but are known to be acceptable in PE recycling	CONDITIONAL Limited compatibility Materials that passed the testing protocols if certain conditions are met OR materials that have not been tested (yet), but pose a low risk of interfering with PE recycling	NO Low compatibility Materials that failed the testing protocols OR materials that have not been tested (yet), but pose a high risk of interfering with PE recycling
Polymer	PE-LD; PE-LLD; PE-HD	multilayer PP/PE	any other polymer
Colours	unpigmented; transparent; white	light colours; translucent colours	dark colours
Barrier	barrier in the polymer matrix	barrier layer EVOH (in polyolefinic combination film); metalized layers	barrier layer PVC; PA, PVDC; any other barrier layer foaming agents used as expandant chemical agents; aluminium
Additives			additives concentration ≥ 0.97 g/cm³
Labels	PE label	Paper label	metalized labels; any other
Adhesives	water soluble (less than 60°C)		
Inks	non toxic - follow EUPIA Guidelines	inks that bleed	toxic or hazardous inks
Direct Printing	laser marked; production or expiry date	printing covering < 50%	printing covering ≥ 50%

Last updated November 2017

RecyClass™
PLASTICS RECYCLERS EUROPE

PE Coloured Flexible film

	YES Full compatibility Materials that passed the testing protocols with no negative impact OR materials that have not been tested (yet), but are known to be acceptable in PE recycling	CONDITIONAL Limited compatibility Materials that passed the testing protocols if certain conditions are met OR materials that have not been tested (yet), but pose a low risk of interfering with PE recycling	NO Low compatibility Materials that failed the testing protocols OR materials that have not been tested (yet), but pose a high risk of interfering with PE recycling
Polymer	PE-LD; PE-LLD; PE-HD	multilayer PP/PE	any other polymer
Colours	light colours; translucent colours	dark colours	
Barrier	barrier in the polymer matrix	barrier layer EVOH (in polyolefinic combination film); metalized layers	barrier layer PVC; PA, PVDC; any other barrier layer foaming agents used as expandant chemical agents; aluminium
Additives			additives concentration ≥ 0.97 g/cm³
Labels	PE label	Paper label	metalized labels; any other
Adhesives	water soluble (less than 60°C)		
Inks	non toxic - follow EUPIA Guidelines	inks that bleed	toxic or hazardous inks
Direct Printing	laser marked; production or expiry date; printing covering < 50%	printing covering ≥ 50%	

Last updated November 2017

8.7 Main NGOs acting in Sustainability

Sustainability:

CDP: Carbon Disclosure Project: https://www.cdp.net/fr

GRI: Global Reporting Initiative: https://www.globalreporting.org/Pages/default.aspx

SBTI: Science Based Target Initiative: http://sciencebasedtargets.org/

Ellen McArthur Foundation: https://www.ellenmacarthurfoundation.org/

Greenpeace: https://www.greenpeace.fr/

WWF (World Wide Fund for Nature): https://www.wwf.fr/

Business:

World Economic Forum: https://www.weforum.org/

The Consumer Goods Forum: https://www.theconsumergoodsforum.com/

Packaging:

Conseil National de l'Emballage: https://conseil-emballage.org/

FNbois (pallets): http://www.fnbois.com/palettes-palox-et-caisses-palettes/

Waste Recovery and Recycling:

FEDEREC: Fédération Nationales des entreprises du Recyclage: http://federec.com/

Revipac: paper and board packaging recycling: http://www.revipac.com/

Governmental

ADEME: Agence de l'Environnement et de la Maîtrise de l'Énergie : http://www.ademe.fr/

Ministère de la Transition Écologique et Solidaire : https://www.ecologique-solidaire.gouv.fr/

8.8 Interviewed people

Packaging Producers:

- Manuli Stretch: flexible film producer
    - Massimo Moroni, sales director

FMCG industrial

- Yoplait – General Mills
    - Florian Trohay, Europe Australia CSR and Sustainability Manager
    - Daniel Lucot, Packaging Expert
- Danone
    - Marie-Pierre Bousquet, Nature 2020 Finance
    - Feliks Bezati, PhD, Circular Economy Manager | Resources Efficiency
- Coca-Cola
    - Emmanuelle Badouix, former Directeur Associé Recyclage
- Continental Foods
    - Sandrine Bigot, Purchaser (and former packaging purchaser at General Mills

Retail:

- Carrefour
    - Bertrand Swiderski: Group Sustainability Director

Waste Management:

- Paprec
    - Philippe Groulez, Sales Director

Stakeholders:

- Eco-Act
    - Nicolas Malpièce, Senior Consultant

Packaging Distributor

- Antalis
    - Steffen Rapp, International Key Account Director
    - Jean-François Singier, Western Europe Supply Chain Director

8.9 Regulatory Landscape

Sustainability is governed by laws, directives, norms and rules in many countries which are, to a certain extent, transcription in national frame of upper level directives set-up by supra-governmental bodies such as EU or UN and this since quite a long time.

It all started at EEC level with the first directive 85/339/EEC dated June 27th, 1985 relative to "containers of liquids for human consumption" with a clear target stated in its Article 1 *"The purpose of this Directive is to provide for a series of measures relating to the production, marketing, use, recycling and refilling of containers of liquids for human consumption and to the disposal of used containers,* ***in order to reduce the impact of the latter on the environment and to encourage a reduction in the consumption of energy and raw materials*** *in this field"*.
This first directive can be considered as a cornerstone although it was limited to primary packaging. But the link between packaging as a whole and environmental impact (reduction of energy and raw material consumption) was made. It fostered member states to develop systems in order to exclude used "containers" from household waste through selective collect in order to "re-use" or "recycle" the recovered packaging. This directive could be considered as a cornerstone in the emergence of environmental actions.
This first attempt was followed by several national initiatives; influenced by the ecological sensitivity of certain member states, laws were more or less stringent, scope-wide and compelling.
After some national development, the need for a harmonized approach was considered necessary and directive 94/62/EC on "Packaging and Packaging Waste" was issued on December 20, 1994. This Directive was completed by decision 97/129/CE relative to material identification and by decision 2005/270/CE relative to Data basis as (article 12 from 94/62/EC) [86]
Main purposes of this directive are:

- Generalization of EPR (enlarged producer responsibility)
- Priority given to packaging waste prevention and recycling through precise guidelines in regards to packaging optimization, material content (hazardous materials) and end-of-life management.
- Replacement of initial directive 85/339/EEC (preamble)

All these directives have had a transcription into French regulatory framework, being laws (with corresponding legislative decrees) or Government ordinances, all texts being integrated into "Code de l'Environnement", a Master Document of more than 2500 pages, covering all rules that need to be followed, in whatever sector. Articles of "Code de la Consommation" regarding false environmental claims [87] need also to be considered in

The French laws and decrees on packaging environmental scope are 6:

[86] https://aida.ineris.fr/consultation_document/1035
[87] Code de la consommation, articles L121-1 to L0121-5

a- Decree n°92-377 & updates (corresponding to articles R.543-53 t R.543-65 of "Code de l'Environnement"): setting-up the basis of Producer Enlarged Responsibility (REP = Responsabilité Elargie du Producteur) which holds the actor (producer, importer …) providing the market with a packaged product should take responsibility for contributing to disposal of post-consumption packaging waste. This disposition led to creation of « Eco-emballage » and "Adelphe" in 1992 to which all companies are contributing to finance all necessary specific collection and sorting facilities (see calculation below).
b- Decree n°94-609 & updates (corresponding to articles R.543-66 to R.543-74 of "Code de l'Environnement"): this article is key as it imposes to all companies, generating or holding packaging waste, to recover it through various schemes outside of the primary packaging already covered by Decree n°92-377.
c- Decree n°96-1008 & updates are the follow-up of Decree n°92-377 defining prevention and recovery of households packaging waste through quantitative targets and set-up of selective waste collection.
d- Decree n°98-638 & updates focuses on eco-design/eco-conception and eco-manufacturing of packaging
e- Law n°2009-967 & updates – and specifically article 46[88]
f- Law n°2010-788 & updates – and specifically article 199[89]

This legal framework establishes a clear distinction between EPR for household waste and non EPR for retail and industrial waste: all packaging is covered but the final step to recovery is relying on different flows depending on waste collection - but managed by the same waste management companies in the end as they are covering the full scope of waste collection and sorting.

Out of 6 laws or decrees, 5 are concerning EPR and primary packaging.
If only 1 is concerning industrial & commercial waste (articles R.543-66 to R.543-74 of "Code de l'Environnement"), it structured a dedicated industry and defined processes and specifications regarding this source of recyclable materials.

The latest text issued relates to GHG emission calculation and declaration for legal entities (being private company, association of more than 500 employees or public bodies of more than 250 employees or territorial collectivity of more than 50,000 inhabitants) according to article 75 of law n°2010—788 of 12 July 2010 (loi Grenelle II) modified by ordonnance n°2015-1737 article 1 [90]dated 24th December 2015. This text imposes to eligible entities to perform the mandatory GHG emissions for scopes 1 and 2 every 4 years. Since 2016, they also have to declare GHG emissions for significant contributors of their scope 3. Failure to do so would result in a fine that cannot exceed 1500€.

88
https://www.legifrance.gouv.fr/affichTexteArticle.do?cidTexte=JORFTEXT000020949548&idArticle=JORFARTI000020949632&categorieLien=cid
89 https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000022470434&categorieLien=id
90 https://www.legifrance.gouv.fr/eli/ordonnance/2015/12/24/DEVR1523496R/jo/texte

In 2020, the "Circular Economy Package" adopted by the EU in April 2018 will be adapted to the French law[91]. Main objectives of this package are reduction of landfills (maximum of 10% of municipal waste by 2035) and increase packaging recycling rate up to 65% by 2025 and 70% by 2030. This target is broken-down by specific material according to the following table:

	By 2025	By 2030
All packaging	65%	70%
Plastic	50%	55%
Wood	25%	30%
Ferrous metals	70%	80%
Aluminium	50%	60%
Glass	70%	75%
Paper and cardboard	75%	85%

Source = EU circular economy package

All these laws and decrees also constitute a basis to levy taxes and contribution with a dual objective: Finance all necessary infrastructure needed and influence changes towards (more) sustainable solutions. In France, this is embodied by:

a) Eco-contribution (only linked to EPR) to finance all specific collect, sorting and recycling infrastructures
b) Carbon contribution (known as "Taxe Carbone" or "Contribution Climat Energie" to limit GHG emissions) to gear energy and transportation sectors towards more frugal solutions.

Evolution de la composante carbone de la TICPE en €/tCO2					
2017	**2018**	**2019**	**2020**	**2021**	**2022**
30,5	44,6	55	65,4	75,8	86,2

This is reflected into the 3 other taxes on electricity, gas and coal.

In addition to the above laws, EC enacted 6 norms [92] to ensure compliance of packaging to basic rules of sustainability:

[91] http://www.europarl.europa.eu/news/en/headlines/society/20170120STO59356/the-circular-economy-package-new-eu-targets-for-recycling
[92] https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/packaging_en

1- EN13427: Requirements for the use of European Standards in the field of packaging and packaging waste
2- EN13428: Prevention by Source reduction
3- EN13429: Reuse
4- EN13430: Requirements for packaging recoverable by material recycling
5- EN13431: Requirements for packaging recoverable in the form of energy recovery
6- EN13432: Requirements for packaging recoverable through composting and biodegradation

These norms have been localized in EU countries by their respective Normative Organizations (AFNOR in France).

Tertiary Packaging is also largely influenced by EU directive 2014/47/UE relating to technical roadside inspection. Article 13 focuses on "inspection of cargo securing". As seen before, the finality of tertiary packaging is to ensure stability and protection of unit loads. But this directive does not give detailed specification, relying on existing norms that are mentioned in Appendix III. Among the 11 applicable norms listed in the appendix, Norm EUMOS 40509[93] from 2012 aiming at securing loads and pallets in the supply chain is of interest as it defines the tolerances of deformation of a pallet during transportation. This deformation is linked to cargo weight (heavy cargo will have the tendency to move more) and tertiary packaging (in quality and quantity). As an example, tolerated permanent deviation of a load cannot exceed horizontally 5% of its total height; temporary deformation (oscillation) cannot exceed 10% of its total height; for multi-layers pallets (which is the case for most of FMCG goods) sliding of one layer versus another cannot exceed 2% of total pallet height. This norm also defines tests that can be conducted to ensure load stability.

[93] http://eumos.eu/quality-standards/

8.10 ISO Normative Landscape

ISO (International Organization for Standardization):

Several aspects of Sustainability are covered by ISO norms in order to help companies assessing, implementing and measuring Sustainability in its various aspects.

ISO14001 for environmental management system (monitoring and improvement of all company processes that could have an impact on the environment, such as Waste Management, Production, Transportation …), including norms ISO14040 and 14044 on Life Cycle Assessment.

ISO18601 and following for Packaging and the environment: Optimization of the packaging system – which is relating to European Norms cited above (EN13427 and following).

ISO26000 for Corporate Social Responsibility (CSR) management system (beyond environment and sustainability, business conduct in regards to Social and Ethics having a positive impact on society)

ISO50001 for energy management system (energy being the focus point of GHG emissions)

Of course, certification of conformity can be delivered by an accredited external auditor to testify about application of and compliance to these rules.

Industrial Companies using these certifications [94] to ensure compliance of their production processes to their environmental commitments and obligations.

https://www.iso.org/obp/ui/fr/#iso:std:iso:18602:ed-1:v1:en:fn:1

https://www.iso.org/fr/news/ref2287.html

[94] « Les pratiques environnementales des entreprises", Sylvie Dumartin, Insee Premières n°1673 – Nov. 2017

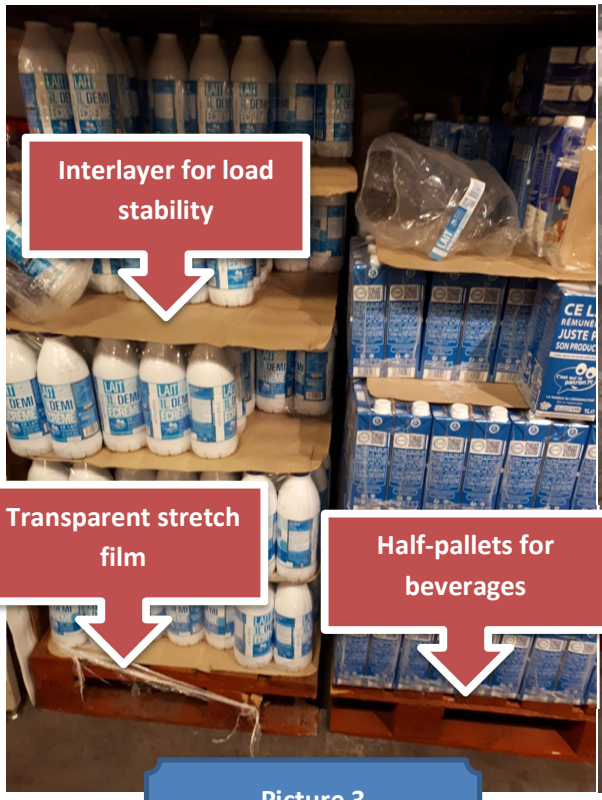
8.11 Illustration photography / pictures

In-store

Pallets

Picture 1

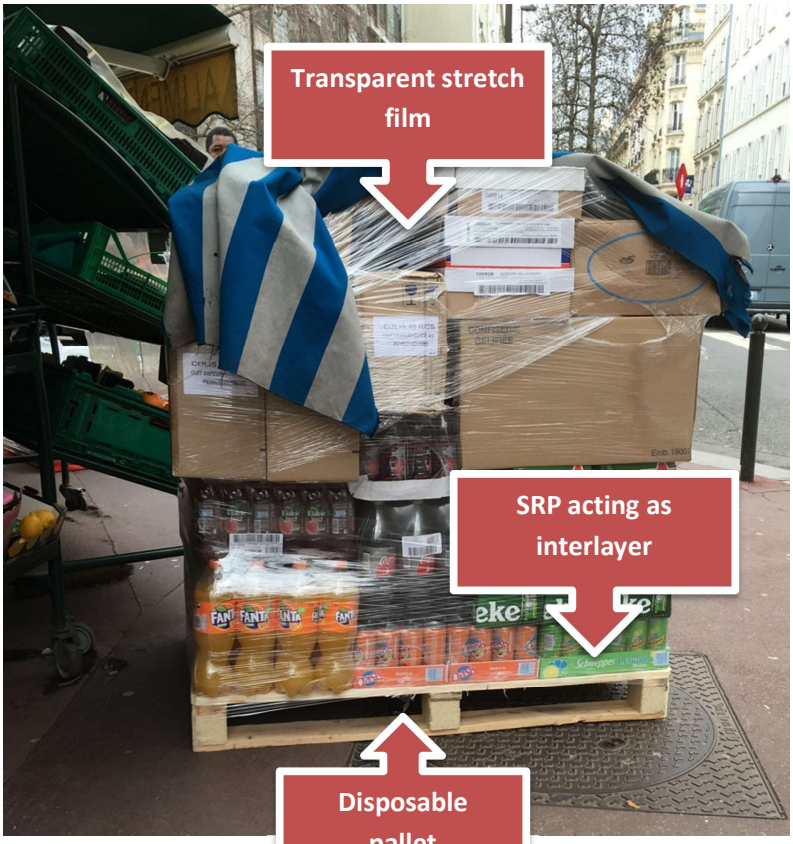
Picture 2



Picture 3

Picture 4

Picture 5


Transparent stretch film
SRP acting as interlayer
Disposable pallet

Picture 6

Picture 7

Picture 8

Picture 9

Picture 10

Picture 11

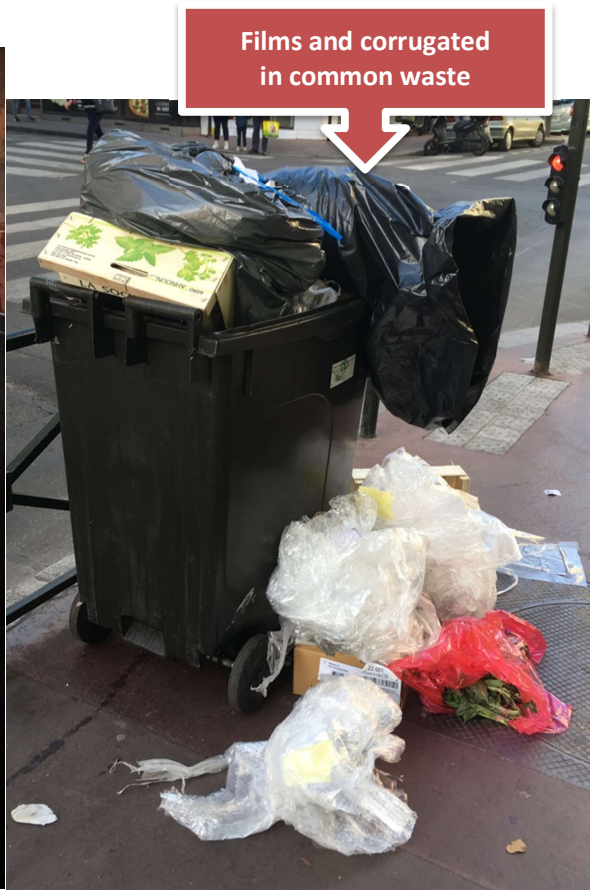
Corrugated bale ready for collection

Picture 12

ready for collection : re-usable packaging and waste

Picture 13

Picture 14



Picture 15

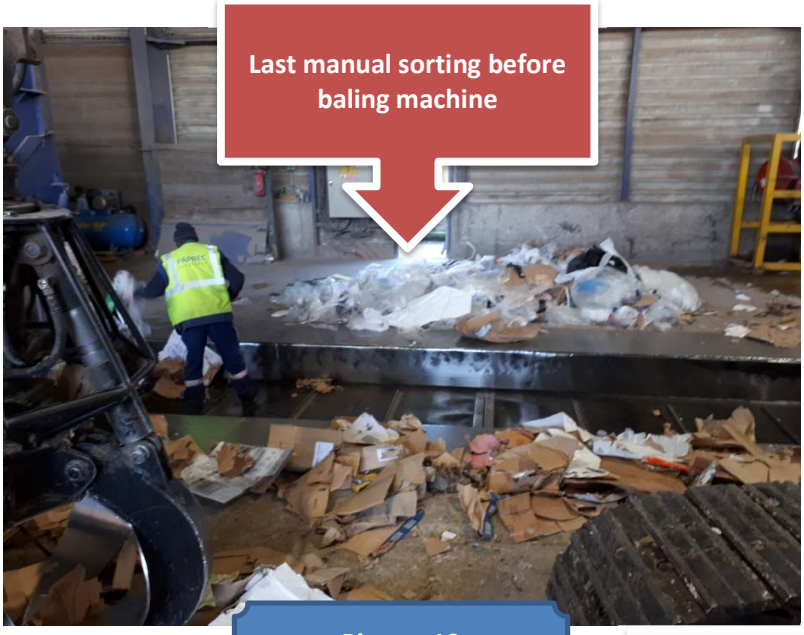
Truck from retail plateform :
Bales of corrugated and films

Picture 16

Bulk corrugated
out of compactors

Picture 17

Picture 18

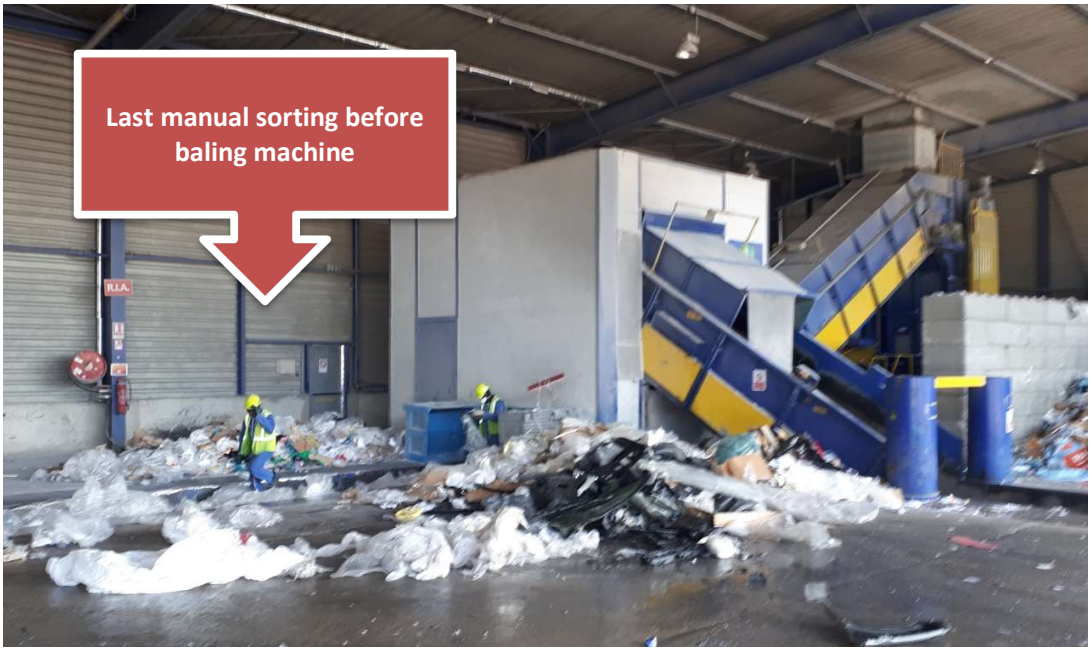


Picture 19

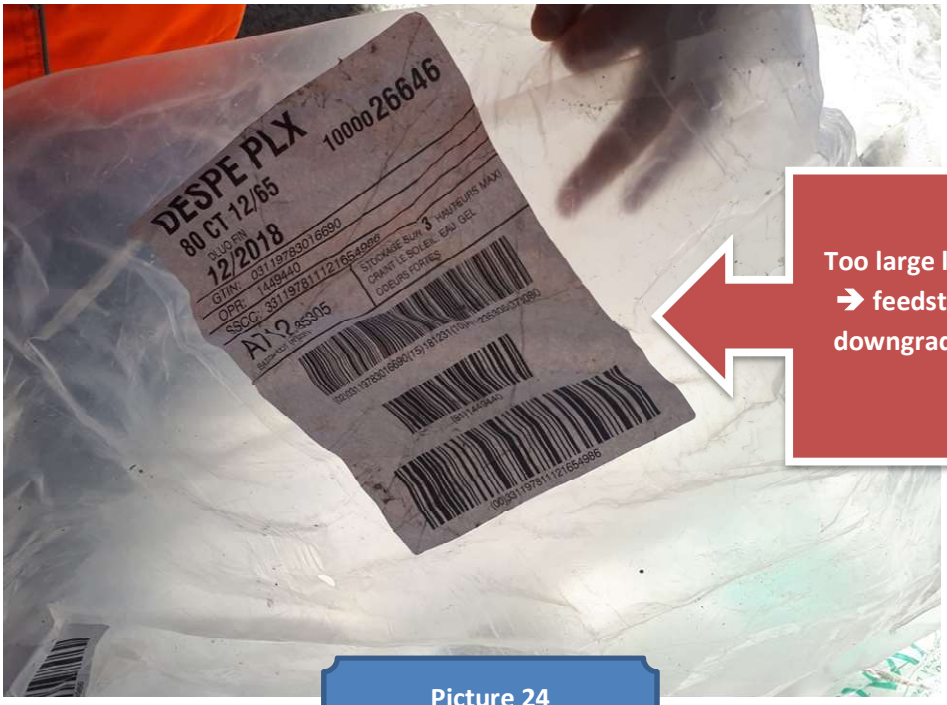
Picture 20

Picture 21

Picture 22



Picture 23



Picture 24

Light film bales out of baling machine

Picture 25

Picture 26

Picture 27