Aalborg University Copenhagen

Aalborg University
Department of Planning - Copenhagen
Campus - M. Sc. Sustainable Cities
A.C. Meyers Vænge 15
2450 København SV
Denmark

Secretary Line Vittrup Jakobsen
Phone: 9940 7204
E-mail: line@plan.aau.dk

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Supervisor:
Supervisor: Arne Remmen
Co-Supervisor: Stig Hirsbak
External Examiner:

Name: Anders Halkier Nielsen
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Plastic Packaging and Practice

A case study in Danish packaging innovations

Aalborg University Sustainable Cities

Master Thesis

Nielsen, A. H.

ABSTRACT

"Plastic is fantastic", those are the words of a Danish television campaign to encourage the recycling of plastic products, aimed at consumers to recycle their plastic packaging. But despite efforts to bring consumers to recycle their plastic, plastic packaging amounts to 40% of all plastic ever produced. Therefore, a lot of efforts have been put into creating new ways to rethink our plastic packaging, to increase its lifespan and to reduce the amount of single-use plastic packaging that goes around.

Initiatives covered in this study have moved to make innovative changes in how we act around plastic packaging and find new methods of consuming goods without needing the dreaded plastic packaging. But plastic is a useful material, and therein lies the problem. New solutions often hit barriers of past systems, thus preventing innovations from taking place.

In this case, innovations should be able to overcome the barriers provided by older systems, either by replacing them, or to create enough consumer drive to force changes around them.

Danish Innovative solutions will deliver a driving power that can bring about change but needs to address their shortcomings to bring about meaningful change. Non-packaging schemes and reuse schemes are only as effective as their accessibility to its consumers.

INDEX

FIGURES & TABLES

CHAPTER 1: INTRODUCTION

Plastic packaging makes up for a surprising amount of the plastic consumed globally, in Denmark alone, 40% of all plastic consumed is plastic packaging. And with new efforts to curb the use of single-use plastic packaging in the EU, it is only fitting to look at the innovators in Danish packaging and search for solutions that will reduce the amount of single-use plastic packaging.

This study will dive into three specific cases of innovations that promotes lesser use of single-use plastic packaging and determine if they are able to cause long-term system innovation in their field. Each case has been picked to create a diverse understanding of the single-use plastic issues and what innovation amounts to in their respective fields.

A fourth case will be engaged, as the French government which in 2022 imposed restrictions and ban in single-use plastic for 30 fresh fruits and vegetables, with long term plans to remove single-use packaging completely from fresh fruit and vegetables by 2026. Without similar Danish legislation, analyzing the French legislation, might give an input to what the possible pushback from the inner EU-market would be if Danish legislators would attempt a similar piece of legislation.

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CHAPTER 2: PROBLEM & DESIGN

Plastic is everywhere! So much anyone can agree on, it is wrapped around our food and drink, wrapped around our electric appliances, it is wrapped around the products we buy or when we transport it, and it is now showing up in the food as well. In general plastic ties itself with consumption of goods.

2.1 PLASTIC ON A GLOBAL SCALE

Since 1950 and up to 2015, some 7800 Mt worth of fossil oil-based plastic have been produced on a global scale – and an estimate suggest that 50% of that, was produced in between 2005 and 2017 (Vingwe, E., Towa, E., & Remmen, A., 2020).

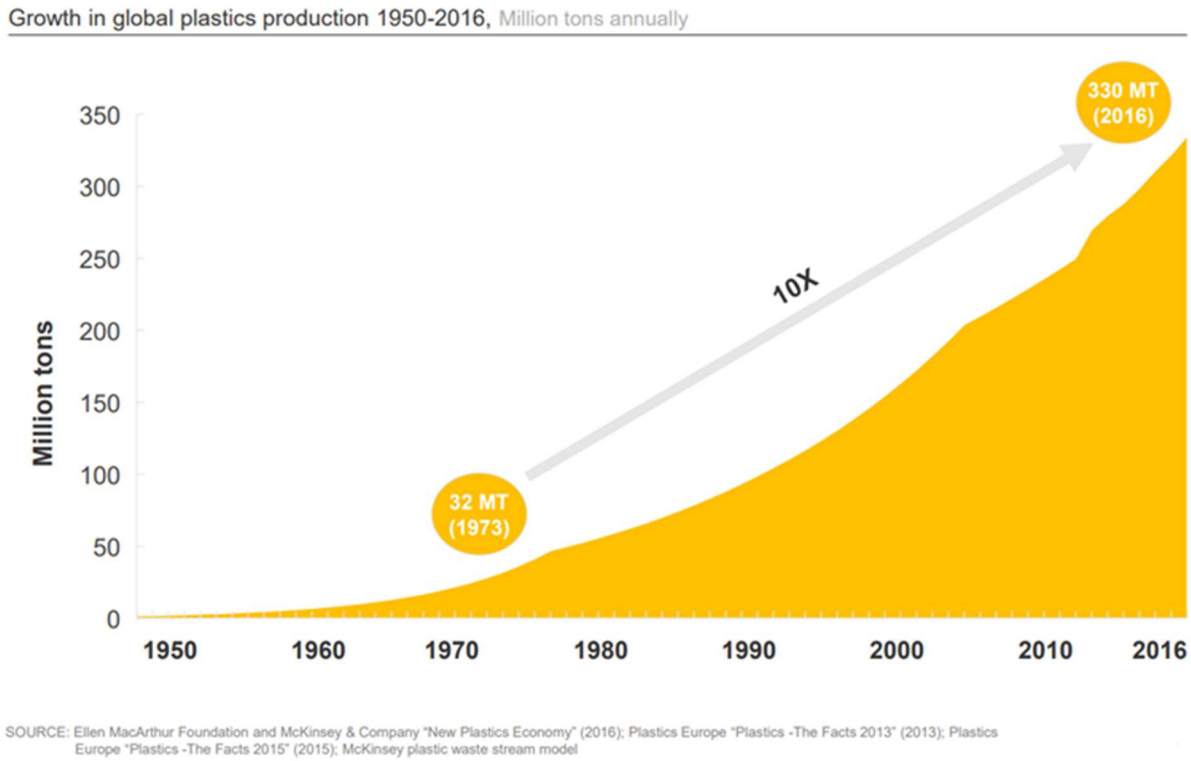


Figure 1 - *Growth in global plastic production from 1950 to 2016* (Mckinsey Foundation, 2019)

By the time of 2016 plastics on a global scale amounted to 8300 Mt. Of this amount 19% remains in use - while 12% has been incinerated and 9% have been through a recycling process. The remaining 60% is placed in landfills or remains lost in nature. (See figure 2 below)

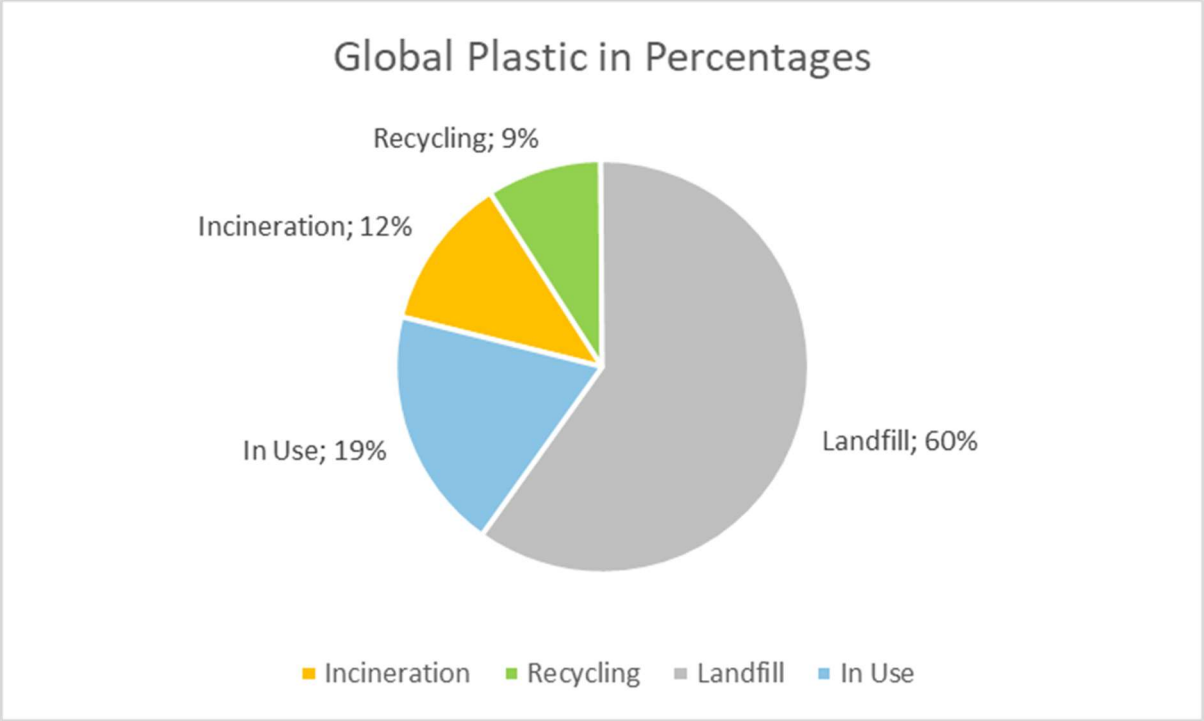


Figure 2 - ***Global plastic in percentages - out of 8300 Mt of plastic produced on a global scale.***

The hazard to wildlife, and the most recent findings of microplastic in the bloodstreams of individuals - the public information campaigns on microplastic and environmental concern, has exploded, plastic has garnered a massive public attention in recent years. And a question arises "What do we do with all this plastic?"

The answer might lie in what we actually use the plastic for. In 2019, the Mckinsey Foundation published a study regarding plastic and its usage for plastic from 2015. Of all the produced plastic packaging makes for 40% of all plastic ever produced

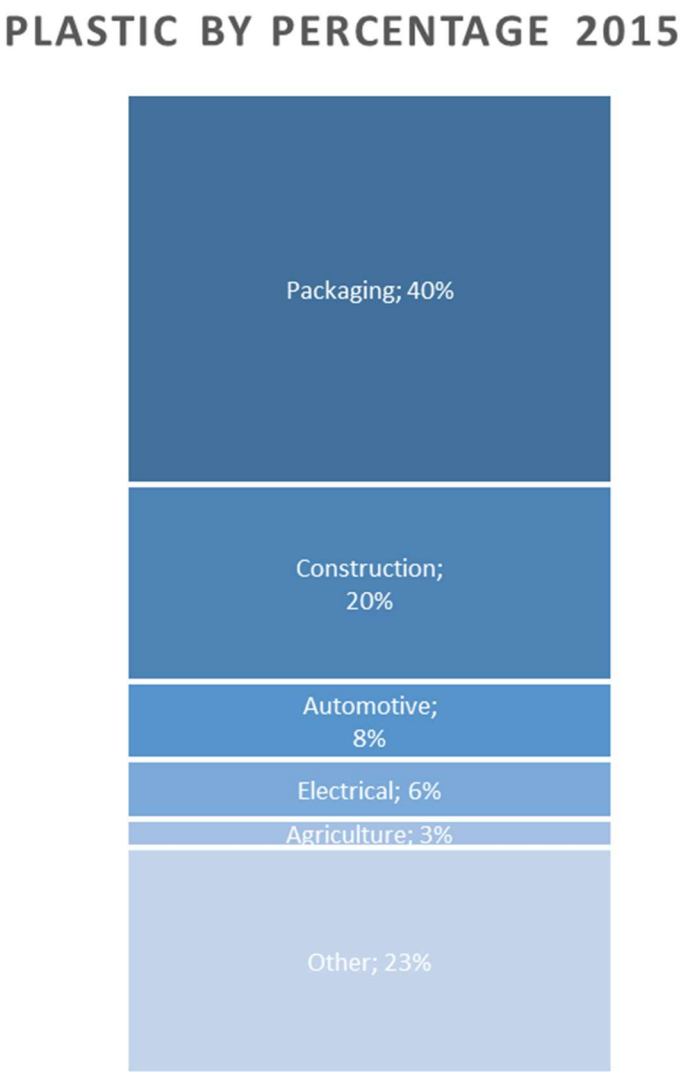


Figure 3 - *Plastic by percentage on world mass by 2015. (Mckinsey Foundation, 2019)*

It will come as no surprise that the answer is not unilateral – Public voices clashing with commercial interest groups. In Denmark the commercial interest group known as Plastindustrien confers a picture that in experience with meeting Danish stakeholders translates somewhat into that the plastic guarantees the quality of life that we perceive of today. And there are reasonable arguments to some aspects of life, that we would be hard pressed to steer away from plastic. Notably the medicinal and surgical sterility offered by plastic, or the resilience of the light-weight material might offer greater savings on CO2 in the long-term – one experiment in Holland showed that making

plastic pallets rather than wood pallets had significant losses to CO2 from transport alone. In a way plastic becomes 'necessary' or a precursor for 'life as we know and enjoy it'.

That is not to say that the arguments on the other side are not valid either, though it often comes across as less coherent. As it strictly deals with the public perception of plastic. Thus, the arguments are aimed at the plastic we see in daily life or what we are exposed to in the media, albeit it is never explained as such. It resonates more as a caricature of: 'all plastic is bad', even if that is not what the public perception takes issue with.

2.2.1 THE PARADOX OF PACKAGING

The paradox of packaging is the supposed idea, that on the one hand we hate the incessant use of plastic in packaging, offering us little to no alternative when it comes to shopping at retailers, since the majority of products today are not available without a thick sheet of plastic wrapped around it. Looking at market developments this becomes more apparent. Looking at developments in world trade from 1950 to 2015 these emerging trends come forward. (See figure 4 below)

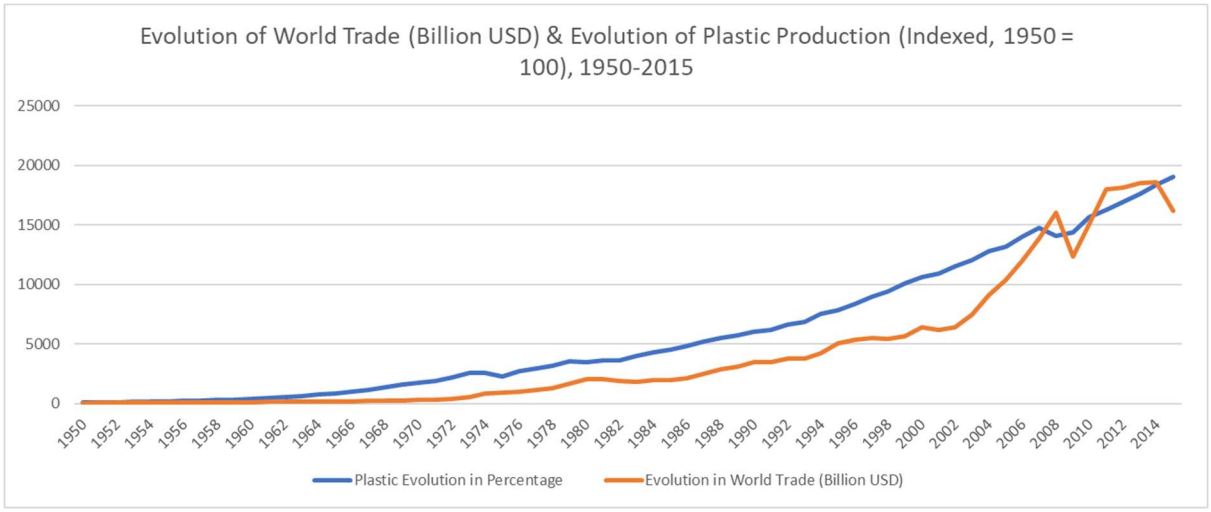


Figure 4 – *Evolution of World trade compared to indexed evolution of plastic production.*

As plastic production increases so does the volume of world trade, with a significant steeping around the late 1980s with the creation of the inner markets. Indexing both dataset and imposing a 1:5 factor on the evolution of plastic production (see figure 5 below), allows the tracing of the two curves, suggesting that the relationship between world trade and plastic has become intertwined helplessly.

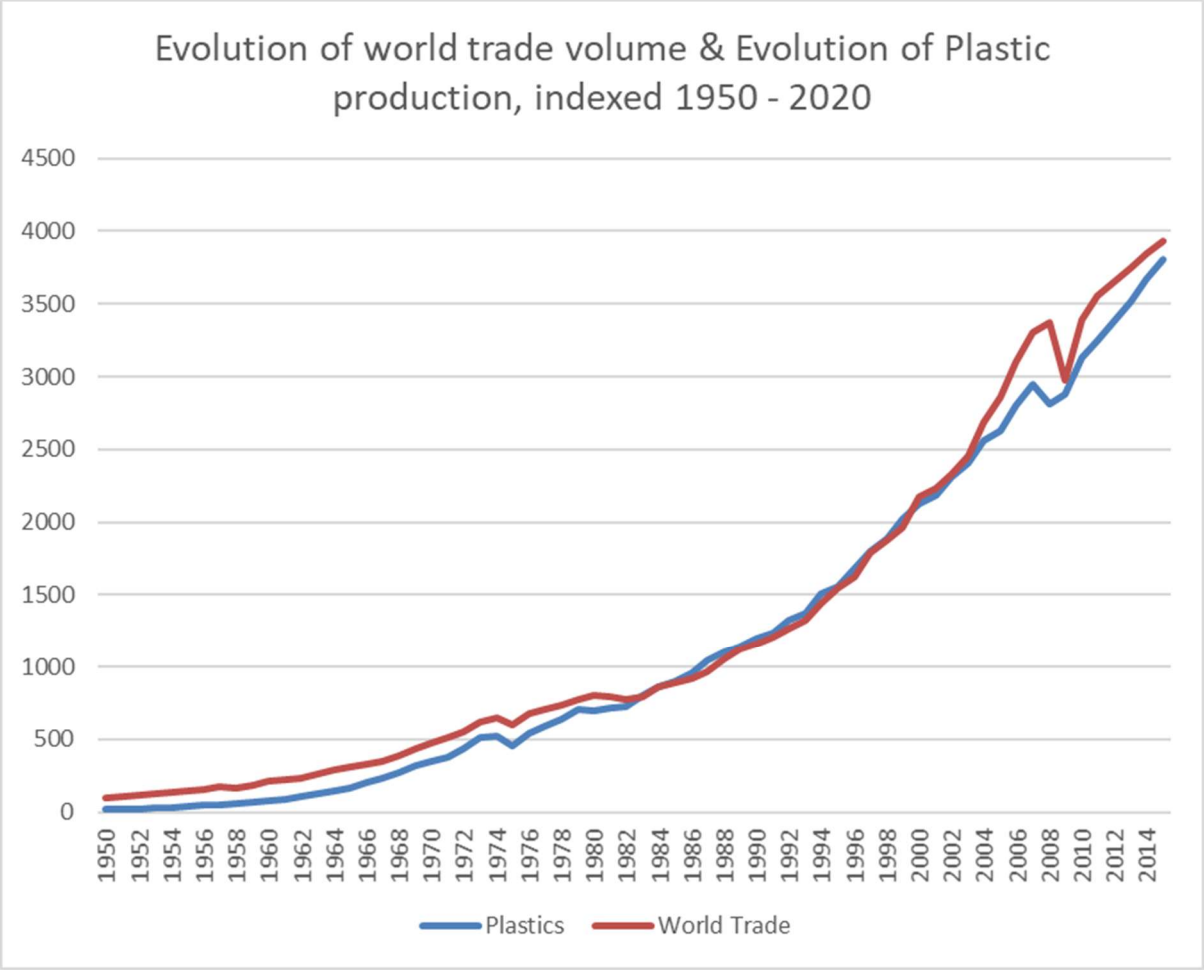


Figure 5 – ***Indexed Plastic and World trade volume. Plastic is on a factor of 1:5 to show the overlap between the two (1% World Trade equals 5% increase in plastic production).***

Though plastic does go hand-in-hand with world trades, studies indicate waste intensity in Denmark has increased over a period despite no apparent changes in GDP, which is commonly denominated to change when business activity rises. (Brix, 2010). This suggests that business activity rises and thus creates new waste intensity without any benefit economically. The danger in that is that we are drowning in market waste without seeing a sufficient pay-off to our economic benefit. And instead, must deal with more waste than before - from products entering the country, without being consumed.

2.2 PLASTIC ON A REGIONAL LEVEL

When the EU in 2018 changed its “directive on waste” and “directive on packaging and packaging waste”, setting new target goals for 2025 and 2030 respectively.

The EU targets set by the Directive on Waste include a minimum percentage of recycled municipal waste:

- 55% in 2025
- 60% in 2030
- 65% in 2035

The EU Directive on Packaging and packaging waste similarly included a minimum percentage of recycled packaging:

- All packaging materials: 65% in 2025 and 70% in 2030
- Plastic packaging: 50% in 2025 and 55% in 2030
- Including Extended Producer Responsibility on

And Directive on the reduction of the impact of certain plastic products on the environment (read: Single-use Plastics[1] and oxo-degradable plastics[2]) to EU-wide ban following items by 2021:

- Cotton buds
- Cutlery (Forks, knives, spoons, chopsticks)
- Straws, except for medical purposes
- Beverage stirrers
- Sticks to be attached to and to support balloons
- Food containers, beverage containers and cups made of expanded polystyrene

[1] Single-use Plastics: 'single-use plastic product' means a product that is made wholly or partly from plastic and that is not conceived, designed, or placed on the market to accomplish, within its life span, multiple trips or rotations by being returned to a producer for refill or re-used for the same purpose for which it was conceived” (Council of the European Union, 2019)

[2] 'Oxo-degradable plastic' means plastic materials that includes additives which through oxidation lead to the fragmentation of the plastic material into micro-fragments or to chemical decomposition' oxo-degradable plastic' means plastic materials that includes additives which through oxidation lead to the fragmentation of the plastic material into micro-fragments or to chemical decomposition. (Council of the European Union, 2019)

(Council of European Union, 2019)

The directive reaffirms the Extended Producer Responsibility (EPR) which defines the producer as:

- Any natural or legal person established in a Member State that professionally manufactures, fills, sells or imports, irrespective of the selling technique used, including distance contracts within the meaning of Directive 2011/83/EU of the European Parliament and of the Council of 25 October 2011 , and places on the market of that Member State single-use plastic products or filled single-use plastic products or fishing gear containing plastic except persons carrying out fishing activities as defined in Article 4(28) of Regulation (EU) No 1380/2013 of the European Parliament and of the Council ;the initial directive points to the act of 'placing packaging on the market". A producer is therefore locked into being the business that places the packaging on the market (for consumption by their customers), therefore could be considered supermarket chains, online e-traders, and so on.
- any natural or legal person established in another Member State or in a third country that professionally sells directly to private households or to users other than private households in a Member State, by distance contracts within the meaning of Directive 2011/83/EU, single-use plastic products or filled single-use plastic products and fishing gear containing plastic except persons carrying out fishing activities as defined in Article 4(28) of Regulation (EU) No 1380/2013.

(Council of the European Union, 2019)

With these major changes the Danish government realized that it had to improve on its own Waste Collection Schemes and produce legislation for Extended Producer Responsibility.

2.3 CONSUMPTION OF PLASTIC IN DENMARK

Consumption of plastic happens all the time, while it is unconscious or not – the average Danish person consumes up to 50 kilograms of plastic each year (Greenmatch, 2018). The main of which is packaging. Packaging is also the hardest to avoid in retailers, where almost everything is wrapped up in plastic, or another packaging profile. According to Greenmatch.dk the average Danish person consumes about 160 kilograms of packaging in total, of which roughly 17% is plastic, an average around 27 kilograms. (Greenmatch, 2018)

In 2017, a total of 438 Kt of plastics were imported or domestically produced in Denmark, excl. 37 Kt imported plastic waste. The same year 240 Kt was collected for treatment in Denmark (Vingwe, E.,

Towa, E., & Remmen, A., 2020). Reduced from a domestic and imported total of 538 Kt in 2011. (See figure 6 below)

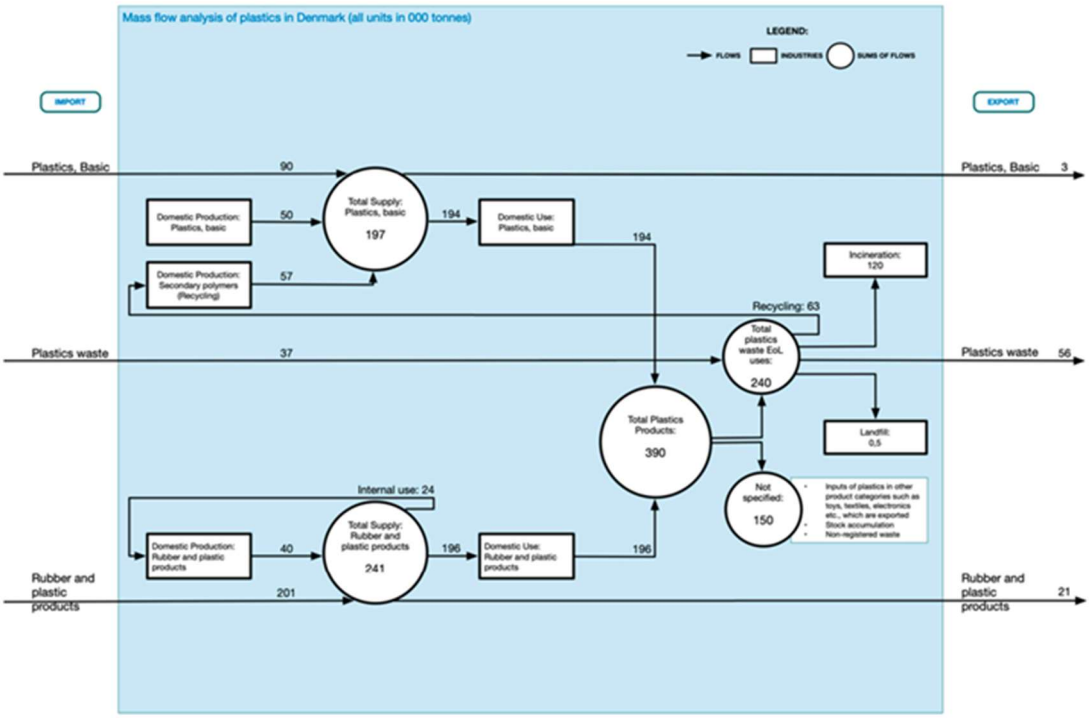


Figure 6 - ***Nowcast Danish plastics Mass Flow Analysis (MFA) based on the combination of Exiobase, 2011 data, and the 2017 trade index data. (Figure from Vingwe, E., Towa, E., & Remmen, A., 2020).***

It is noted that by 2017, not all of households in Denmark had collection schemes that included curb-side sorting, nor availability to turn over packaging that had been contaminated by food or food waste, thus leaving room for discrepancy. This is due to Danish waste treatment practices that before 2021 did not include plastic waste as a mandatory curb-side collection.

Of the collected 240 Kt of plastic waste, 215 Kt is considered plastic packaging. Of which 120 Kt was incinerated, 63 Kt was recycled, 56 Kt was exported, and 0.5 Kt was landfilled. (Vingwe, E., Towa, E., & Remmen, A., 2020).

Figure 7 - ***Plastic Waste Handling 2017, giving in percentages. (Own Figure – Data from Vingwe, E., Towa, E., & Remmen, A., 2020)***

The 2017 trade index – figure 6 (Nowcasted) suggests that 63 Kt of material was sent to recycling with an output of 57 Kt new plastic. Before 2018 it was common practice that recycled material be calculated from the amount that was sent to recycling, not the actual recycled mass afterwards. Meaning that in 2017, as seen on the figure 7 above is given as 26%. However, with the reformed directives of 2018 there is a clear indication that it is no longer accepted to calculate the recycling percentage on the amount of plastic sent to recycling.

This is due to the process of recycling, either because of natural loss in the recycling process or pre-sorting of the recycled material, there is a reduction in materials that legitimately goes to recycling, and thus there has been and argument for either weighing the material after pre-sorting, but before production, or after production. In that case, Danish recycling would lie somewhere closer to 24% in 2017 due to a 90% efficiency in input-materials to output materials (from 63 Kt to 57 Kt materials in the recycling process).

Having been studying at a time where the Danish government has expanded the waste collection schemes (WCS) in Denmark, doing interviews or having conversations with citizens. Citizens were often willing to deal with plastic differently, but also had varying degrees of awakening to what could be described as a 'plastic threat'. Be it simply from their overfilled waste containers in their driveway, threatening citizens to not get all their plastic waste removed from the premises. To a

more subtle awakening of their bin finally making them realize just how vast an amount of plastic they have.

So, whether the origins of wanting to abolish plastic stems from fear of a clogged container with plastic, a deeper understanding of one's own consumption and/or environmental understanding – there is a desire to get rid of a lot of unnecessary plastic.

Denmark has an estimated food waste of 700.000 ton per year (Miljøministeriet, 2015). More than a third of which is wasted in households (260.000 ton). Of that - excessive purchases, excessive cooking, throwing away good products are some of the main reasons Danish citizens give for creating food waste. (Stancu & Lähteenmäki, 2018) Suggesting that, Danes do not in fact gain from the 'safety' of plastic or the longevity of the product when large quantities still are being thrown to waste. There is an element of behavioral discourse that somewhat escapes us as consumers, but not in the way that is normally peddled to us.

The study of Stancu & Lähteenmäki (2018) further goes on to show that roughly 60% of Danish households cook dinner from raw ingredients/produce at least 5 times a week. Showing a large preference for fresh produce. And an avoidance of ready meals. However - when it comes to packaging, having to answer if they agree or disagree to whether they would prefer pre-packed or non-pack produce, an overwhelming 55% of consumers would be indifferent to packaging, and 25% disagree.[3] This means largely that only 20% would conscientiously avoid plastic if they could, and change their practices to avoid packaging.

Leading back to a past where we had a different type of consumption style, with grocers, butchers, green grocers, and day-to-day milk delivery. A time-consuming effort, when you can now walk down into a supermarket and access all four, provided you are willing to buy plastic in bulk.

And buying plastic-in-bulk is exactly what we do, as mentioned before. Considering that no retailer is the same – I dared to do an unofficial trip down to the supermarket buying an average 1000g raw ground beef box. Now the box itself is what you would expect of it, weighing about 11,5 grams on a household kitchen scale. The date of production was 09.03.2022 and the expiring date was

[3] Note that this number might have changed in the years following the Covid-19 outbreak at time of writing, suggesting that this might have been in the favor of pre-packed produce.

16.03.2022. So, every time we lengthen the lifetime of this product it costs roughly 1% of the product's weight in plastic. That might not seem so bad, until you begin examining other products whose weight are vastly different in proportions. Same boxes might be used for much more expensive cuts of beef, chicken, or mutton – and thus, the proportion shifts in favor of the plastic.

2.3.1 DANISH LEGISLATION

There is at present time of writing no Danish legislation on Extended Production Responsibility regarding single-use plastic, the state have provided definitions presented to the Danish industry association and other collaborators with the government in forming out the new legislation. (See figure 8 below)

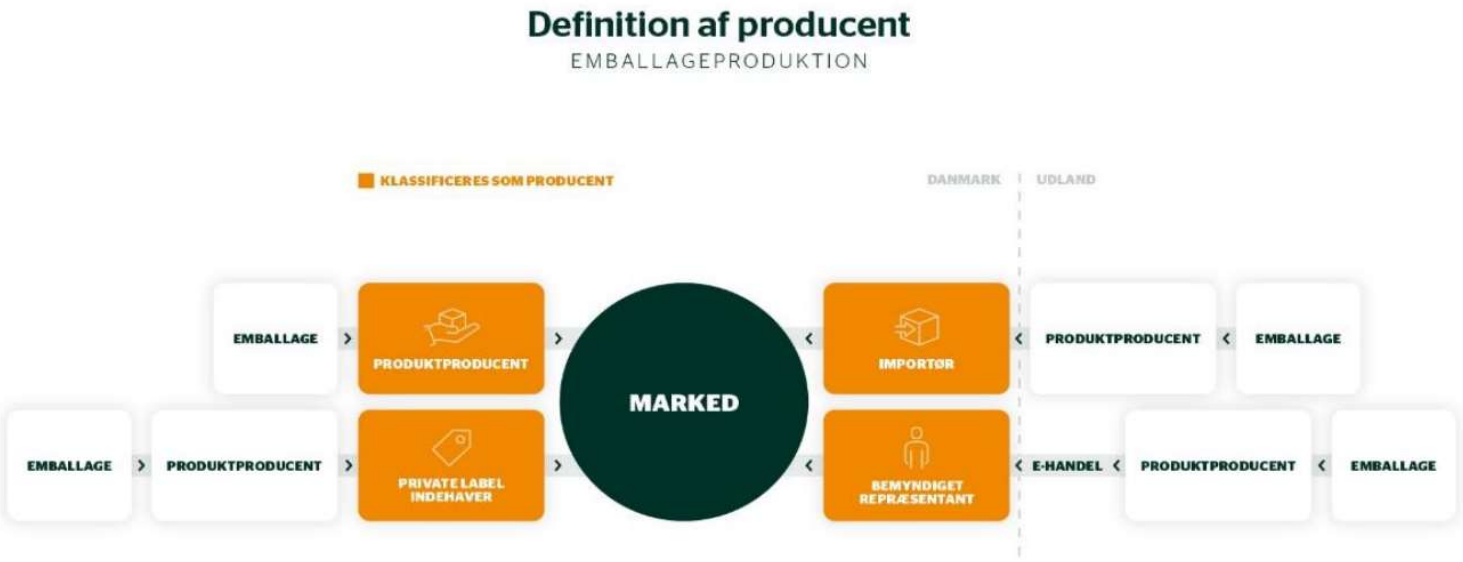


Figure 8 – ***Definitions of companies responsible for placing products on the market. (Ministry of Environment, 2022)***

The four definitions seen here relate to who is responsible for packaging in different types of market schemes, with simplified value chains attached to them.

- Product Producer
- Private Label Owner
- Importer
- Representative of e-trade

2.4 VISIBLE AND NON-VISIBLE PLASTIC

Defining what makes up visible plastic is not an easy endeavor, as individuals are armed differently with awareness and information when they are shopping. Customer's shopping might, as suggested by Greenmatch 2018, shop to avoid packaging waste later down the line, but there are product packaging that cannot be avoided, which means that consumers might be aware and have the information to avoid said packaging, but unable to do so. To distinguish between the plastic we can avoid now, and the plastic we cannot avoid now is one part of a matrix. But also, whether we can visibly engage with the choice ahead of time.

The COVID-19 pandemic at time of writing drove a lot of internet shopping through the roof. Groceries delivered to your doorstep enjoyed a boom with both Dansk Supermarked and COOP opening delivery services and the existing company NEMLIG, saw a rise in deliveries. Deliveries were packed in plastic boxes, then wrapped in a plastic bag, which could be delivered to people's doorstep. The advantage of the plastic bag in this case is time, as handling every item as a singular item would cause a reduction of handling hours.

Initial critique fell quickly on the packaging method, citing the amount of plastic being an issue. COOP, Føtex and NEMLIG each tried other solutions such using cardboard boxes for non-refrigerated goods and Styrofoam boxes for refrigerated goods. This solution was not ideal for all customers either however, as the boxes took up much more space, in tandem with the delay between deliveries, made the solution of harboring and reusing the cardboard boxes impossible, and like the plastic bag returned to the waste bin instead. This creates an uncertainty for companies when boxes cannot be returned to them, and consequently creating more long-term lasting boxes for deliveries could risk people keeping them or not returning them due to the timespan between one order and then next.

Some companies that own regular deliveries, such as Intervare – which specializes in serving clients that are unable to handle their shopping themselves, have the possibility of guaranteeing weekly deliveries to their clients, employing supporters to call and help create a weekly shopping list for their clients.

This of course further eliminates the ability to pick groceries without packaging but allows for innovation where the deliveries are done in boxes that can recirculate, without plastic waste.

Therefore, when discussing plastic-packaging and referring to 'visible' plastic, this report endeavors to understand visible plastic as that which can consciously be avoided by consumers, and 'non-visible plastic' as the plastic that cannot be consciously avoided, regardless of the origin.

By establishing the awareness of plastic that is non-visible, customers might be exposed to plastic. That they can become aware of the 'non-visible plastic' influence their opinions and establish where they can grapple with market forces to reduce the amount of plastic they are exposed to. This arena is an important part of understanding the powers that might be at play, of where citizens can operate without knowing that their products have several steps involved in plastic before it ever greets them on the shelves.

But not all customers are inclined to be the first movers on this issue. Back in 2019, Kantar Worldpanel released research pointing to 48% of customers (65,000 people, in 24 countries) expecting manufacturers to take the lead when it comes to the reduction or removal of single use plastic (Walton, 2020). 19% believed it should be consumers, 24% believed it should be the government and 7% on retailers.

That lack of transparency must be investigated further, both in terms of how aware people are, and how there is a chance for stakeholders to push back against the use of plastic in their food chain.

Because choices to avoid plastic, simply by buying fruit and vegetables from your local greengrocer, or meat and chicken produce at your local butcher, can be available alternatives – preventing any consumption of one-use plastics - requires the local stakeholders to act as well.

2.5 PLASTIC PACKAGING

Challenges surrounding packaging are many – though we are often led to believe that we can just rid ourselves of the packaging all together, as mentioned before there are some arguments that challenges the transition from one type of packaging to another, or no packaging at all. In Brujnes et al., (2020) The barrier for sustainable packaging is listed as 11 direct reasons, including 2 in-direct reasons that come from societal or regulatory measures.

Barriers noted in the State of Sustainable Packaging, include the following:

1. For a long time, packaging materials were a relatively minor concern or the final piece of the puzzle before putting a product on the market. It should be noted that there are differences between sectors. For cosmetics, for example, the packaging serves a far more important marketing function than for example Do-It-Yourself products.
2. The co-evolution of packaging materials and products makes sudden changes to packaging materials alone difficult to implement.
3. Requirements in regard to the marketing, sales, visibility and turnover rate of products are often at odds with sustainability concerns. Fortunately, we do see some changes in this regard: in more and more businesses, marketers opt for the sustainable alternative, even at the expense of their product's original appearance.
4. The innovation of the packaging for new retail (e-commerce) still lags behind this development, which often leads to overpackaging (such as the use of large outer boxes). The sector is gradually taking measures to resolve this issue.
5. Economy and convenience often beat austerity.

Barriers related to existing Plastic Packaging materials and their recyclability:

6. Plastics are exceptionally versatile and flexible, making them hard to replace as packaging materials in terms of functionality. There is a gradual transition towards laminated paper and cardboard, which often represents a step in the wrong direction in regard to the objective of achieving higher recycling rates.
7. Recycling and circularity are ultimately not sufficient enough to resolve the packaging dilemma. Based on high yields for collection, sorting and recycling, the maximum yield of the entire recycling process is barely more than seventy percent. Even the higher yields of e.g. deposit schemes do not result in completely closing the chain.
8. Although business investments shape production processes in the long run, they are directed by short-term interim goals in the here and now. The interim goal of 100%

recyclability by the year 2025 is at odds with the recycling yields that are actually feasible (see point 7).

9. In terms of both price and quality, the economy of recyclates and intrinsically sustainable solutions still loses out to the use of virgin materials from fossil resources. The adaptation of non-food packaging materials made from recyclate is still too limited (as a result of the colour, scent and appearance of the recyclate packaging).
10. The trend of lower packaging weights and dematerialisation impedes the economy of scale for recyclates, as is the case for e.g. light complex laminate packaging.
11. A wide range of different plastics and additives are being used. There is hardly any insight in the presence of potentially hazardous interferants in packaging materials and how these behave after recycling.

Societal and regulatory influenced barriers:

12. The diverse and direct interest-dominated response from society is mounting.
13. In many cases, legislation precludes the use of recycled materials for food packaging.

(Bruijnes, et, al., 2020)

The first five barriers collectively are represented in multi-level perspectives, that there are issues with reaching an innovative solution to replace the existing regime of packaging.

You cannot continue using current packaging methods, but you cannot abandon them either. After all, the intrinsically sustainable alternatives are not available yet.

(Brujnes et al., 2020)

The barriers are linked to the disruptive innovation provided by Geels (2008), noting that an innovation to an existing system cannot come across if these five are not overcome. So any innovative solution offered should cover these barriers concerns, and offer a solution to how policymakers can assist in the turnover.

The six barriers after the initial five, (6. - 11.) cover the material itself - thus can be dismissed if the product can avoid recyclability all together. Such as reuse or collection schemes that avoid the packaging ever becoming waste. While this will not be possible to exchange every plastic packaging product with a reusable one - and some plastic products might offer unique logistic possibilities.

And the last two barriers (12. & 13.) should be covered by practice theory or understanding national sentiment and its composition for recycling, collection schemes, or ‘throw-away’ culture. Denmark

notably has a collection scheme revolving around juice, soft drink and water bottles and cans. The return rate for bottles and cans in this manner is 92% in 2020 (Dansk Retursystem, 2020), and companies that mimic the model of collection schemes have found similar collection benefits, with Kleen Hub, which provides coffee shops and restaurants with stainless steel solutions instead of the common cardboard cup, noting up to 98% return rate on their products (Freiesleben, 2021). Though that may be attributed to the price of their packaging. Customers are expected to pay 100 DKK for take-away boxes or 150 DKK for a coffee cup. The product is then borrowed for 10 days, and once returned you get your money back (Freiesleben, 2021). Any delay on the product will cost you 10 DKK, substantially reducing the desire for late collection.

This gives rise to look further into reuse collection schemes, as it has a tradition in a national level scaled understanding, using what we already know. And while Kleen Hub insists they are not a collection scheme, but a rental scheme, the effects are the same - giving value to packaging that would otherwise have no value at all after its initial use.

The Danish context thus must be assumed to understand the idea of reuse collection schemes and with the right incentive could be expanded upon.

2.6 SUMMARY

The general issues of transitioning away from plastic packaging seems to be at best founded in the narrative and the consumption behavior of the public. The narrative exposed to us is largely that the consumer is responsible for what they put in their basket, and thus also responsible for the waste that they generate, and thus must dispose of thoughtfully within the local means of doing so. However, packaging serves a much larger system that the public is exposed to. The decentralized consumption system provides out of season fruit and vegetables, and as established the desire for fresh produce over frozen options are largely preferred by the public. This would in turn largely reduce the market functions that the free market is built on, and that ensure fresh produce that retailers and supermarket chains have established across the EU. One would only have to look to Brexit to see how many trolleys and trucks pass the channel to get a sense of the scale of this operation if impeded by limitations. Economic and social sustainability lack somewhat behind simply getting rid of the packaging.

Packaging-free solutions, however, seem environmentally attractive the more and more pressure is put on the public to sort its packaging waste, which are getting more and more intricate in its design. In essence grappling the problem by the head and dispelling 40% of all plastic products produced today. This however would not alone solve the issue that food waste is prevalent in the way we deal with centralized production for decentralized consumption - and the behavior of which we as citizens consume food. The 20% who actively prefer non-packed produce over pre-packed produce do not make up a sufficient base to change the demand of plastic packaging alone, thus making the pressure for policy or manufacturer changes. Which in turn waits for technological advances - before giving up past systems all together.

There are however possibilities in schemes that avoid recycling all together, making the way for reuse collection schemes, especially in the Danish context where it has taken root through Dansk Retursystem, which runs a collection scheme for bottles and cans used for:

- Beer,
- Mineral Water,
- Lemonade (both drinkable from the shop or to-be-mixed with water) and other carbonated drinks,
- Non-alcoholic drinks mixed with alcohol (Such as soda containing alcohol - including yeast-based alcoholic sodas),
- Fruit- and/or Vegetable Juice.

(Ministry of Environmental Affairs, 2020)

The bottles are then taken to a local supermarket or one of the collection schemes stations across Denmark.

Figure 9 – ***Danish Return System for single-use plastic bottles. (Foto: Ty Stange - Flaskeautomat | Dansk Retursystem (ritzau.dk))***

The system is an integral part of Danish culture, thus amplifying it or mimicking it might prove some interesting innovations unique to the Danish palette. Even though the system lately has been taking a broadside due to increased consumption, newer systems have been developed to handle them quicker (Estimated at 120 plastic bottles a minute). It is uncertain if these newly developed systems would be applicable to packaging.

Dansk Naturfredningsforening pointed to an experiment conducted in week 11 of 2022, that on average, the families that partook in the experiment managed to produce roughly 2,6 kg single-use packaging, 50% of which was identified as soft single-use plastic over a week. The focus on packaging was noted by 75%, who also made efforts to reduce their consumption of packaging.

2.7 RESEARCH QUESTIONS

The foundation of the research question is trying to define what practices (niches) could be implemented to change the way we consume plastic products (regime). While governments like France and Netherlands are pushing the plastic industry with innovative legislation; Denmark is trying to catch up and meet EU legislation on market introduction of plastic by 2025. With inspiration from local, national, and international ideas, what options do we have for innovation and who must be responsible for it? In this report I will primarily discuss plastic packaging as a primary form of packaging. While a lot of invisible packaging exist beyond consumer eye, these needs to be changed by solutions proposed by national or regional legislation, as consumer practices will often be unaware of invisible plastics.

Research Question: What examples of innovative solutions could change the consumption of primary plastic packaging in Denmark?

Subquestion 1: What advantages and disadvantage does the new solution have for changing the practice of consumption of primary plastic packaging?

Subquestion 2: What are possible ways to implement them on a(n) local, national, and international scale?

Cases have been chosen to reflect different innovative strategies in Denmark that pushes for innovation on plastic packaging, as well on different levels of actors, varying from independent actors to collaborations to legislative actors as the main-product holder or innovative mover. One cases which relates to the full ban of single-use plastic of fruit and vegetables in France. As there are no current Danish legislation regarding the extended producer responsibility.

CHAPTER 3: THEORY AND METHODOLOGY

This chapter covers the theories and the methodology applied in the report. Taking an offset in understanding the wider picture of innovative solutions, and which actors are responsible for changes before moving on to analyzing the solutions that are possibly in relation to plastic and plastic packaging.

3.1 THEORY OF MULTI-LEVEL PERSPECTIVE

Multi-level perspective is a theory that relates to changes in an established system and innovating these systems through a disruption of the established systems. Though often misunderstood as one technology's replacement for the other. Multi-level perspective theory acknowledges that to create an innovation in an existing system and lists criteria for what makes a system innovation:

- They involve co-evolution of a number of related elements;
- They involve changes in the supply side (e.g. technology, knowledge, industry structures) and the demand side (user preferences, cultural meaning, infrastructure);
- They involve a wide range of actors;
- They are long-term processes (evolving over decades). This presents challenges for effective and consistent policy interventions over political timescales, and also for the analysis of ongoing transitions under policy interventions.

(Geels, 2006)

System innovation operates on three levels of hierarchical value, Meso, Macro and Micro. In the micro-level features what Geels (2006) refer to as 'technological niches' that distincts itself from the Macro-levels where 'technological regimes' take place. These niches are locations where deviating from the path of Macro-level features, and within their protected spaces actors can steer the system innovation, hoping to either embed or cause a transition to their niche. The four criteria Geels (2006) points to, are necessary to create protected spaces for technological niches that they might replace existing regimes.

The co-evolution of a number of related elements; defines an adherence to the rules of the macro-level, in order to cause a transition, there must be an alternative to the existing regime. One of the more common issues with Electric Cars for example used to be the range and lifetime of their batteries, availability to recharge stations, etc. The co-evolution of each element had to be in place for it to be possible not just to experiment, but to ensure a workable transition prospect.

It is interesting to note that this co-responds to some of the arguments against the abolishment of packaging elaborated by The State of Sustainable Packaging (Brujnes et al., 2020) – including the dismissal of abolishment or removal of packaging as follows:

You cannot continue using current packaging methods, but you cannot abandon them either. After all, the intrinsically sustainable alternatives are not available yet

(Brujnes et al., 2020)

Dismissing the possibility of abandoning current packaging methods is thereby established through the absence of a system innovation that meets the criteria, suggesting that either the structures or technology are necessary from the supply side, despite demands urging for things to be otherwise. This allows us to assess the argument closer when analyzing possible solutions to the packaging dilemmas.

The State of Sustainable Packaging, describes how one of the dilemmas facing plastic packaging is the co-evolution of packaging and the products, states *"[…] makes sudden changes to packaging materials alone difficult to implement."* (Bruijnes, et, al., 2020).

They involve changes in the supply side and the demand side; No change ever happens without a new solution to solve the problem, and without people asking for that kind of change. A new technology, concept, or new way of handling packaging can only come about if there is a demand for it.

As established earlier – there are a demand for reduced packaging from the public, but not a clear solution to how to do it. The existence of push from the consumers fills to a boiling point where the suggestion of getting rid of packaging all together might seems a better solution, without being willing to give up the convenience of said packaging. This causes a split with co-evolution of elements because consumers might often only be introduced to one aspect of the full system innovation.

There are examples of cultural meaning, infrastructure, and industry structures that pull away from having an innovative solution. Despite the cultural meaning acting in a reinforcing way of the innovation, it clashes with the capabilities.

They involve a wide range of actors; covers the stability of a product. The wider the range of actors the stronger the foundation and protected space of the niche. Actors can provide much needed knowledge and network that an up-and-coming solution does not initially have. Creating an alternative to plastic packaging, it needs some support to implement it further to bring about the change. NGOs, universities, and associations that would like to see change to a common practice are useful actors to involve. (Geels, 2006)

They are long term processes […]; is defining that change does not happen from one day to the next, and as such expecting the change to come overnight fails to understand that you need the support of your actors and a constant evolutionary process of the product, clients or consumers, value chain and actors.

Multi-level perspective theory does, ask solutions to be scrutinized. To understand that a single aspect of the innovation is not enough to cause a disruption to bring about change. Once a disruption becomes a solution to an existing problem, it is then possible to either try and expand it, either through the long-term processes and policy management or through the natural growing interest in the solution. Danish innovations such as Prounit Frames solution to separate plastic, cardboard and aluminum from juice cartons are currently only on a technological development stage but are gaining interest from investors and actors on the market.

Table 1 – Barriers for packaging (Bruijnes et. al. 2020)

Barriers for Packaging	Barriers for Recyclability	Societal and Regulatory influenced Barriers
1. For a long time, packaging materials were a relatively minor concern or the final piece of the puzzle before putting a product on the market. It should be noted that there are differences between sectors. For cosmetics, for example, the packaging serves a far more important marketing function than for example Do-It-Yourself products. 2. The co-evolution of packaging materials and products makes sudden changes to packaging materials alone difficult to implement. 3. Requirements in regard to the marketing, sales, visibility and turnover rate of products are often at odds with sustainability concerns. Fortunately, we do see some changes in this regard: in more and more businesses, marketers opt for the sustainable alternative, even at the expense of their product's original appearance. 4. The innovation of the packaging for new retail (e-commerce) still lags behind this development, which often leads to overpackaging (such as the use of large outer boxes). The sector is gradually taking measures to resolve this issue. 5. Economy and convenience often beat austerity.	6. Plastics are exceptionally versatile and flexible, making them hard to replace as packaging materials in terms of functionality. There is a gradual transition towards laminated paper and cardboard, which often represents a step in the wrong direction in regard to the objective of achieving higher recycling rates. 7. Recycling and circularity are ultimately not sufficient enough to resolve the packaging dilemma. Based on high yields for collection, sorting and recycling, the maximum yield of the entire recycling process is barely more than seventy percent. Even the higher yields of e.g. deposit schemes do not result in completely closing the chain. 8. Although business investments shape production processes in the long run, they are directed by short-term interim goals in the here and now. The interim goal of 100% recyclability by the year 2025 is at odds with the recycling yields that are actually feasible (see point 7). 9. In terms of both price and quality, the economy of recyclates and intrinsically sustainable solutions still loses out to the use of virgin materials from fossil resources. The adaptation of non-food packaging materials made from recyclate is still too limited (as a result of the colour, scent and appearance of the recyclate packaging). 10. The trend of lower packaging weights and dematerialisation impedes the economy of scale for recyclates, as is the case for e.g. light complex laminate packaging. 11. A wide range of different plastics and additives are being used. There is hardly any insight in the presence of potentially hazardous interferants in packaging materials and how these behave after recycling.	12. The diverse and direct interest-dominated response from society is mounting. 13. In many cases, legislation precludes the use of recycled materials for food packaging.

3.2 THEORY OF ACTORS NETWORK

There is a slew of literature to dig into when grappling with networks and actors, especially because their power structures are very different from public, to private to public-private companies and institutions, along with the industry itself. Sources like A. Wolff (2020) pushes the boundaries between public power wherein investiture of the public is pushed onto elected officials, who with their transfer of power invest it in departments of planning, education and more (Wolff, 2020)., Whereas private power structures often rely on supply/demand structures, market shares and economic power.

The Actor is often misunderstood as the sole actors in the actor-network, but is influenced by his surroundings, fellow actors, and the regime in which he acts (Latour, 2005).

Multi-level perspective theory acknowledges that actors and stakeholders are a part of the innovative process, thus it is important to understand which actors operate within plastic packaging and possible innovative solutions.

A network to boost sustainable packaging or a transition into non-packaging solutions must therefore be established to prevent it falling through.

3.3 THEORY ON PRACTICE AND PRACTICE CHANGE

Practices and Practice changes in relation to plastic and plastic consumption are not a new discussion to be had in a sociological state, and while it is tempting to tie this into habits and preferences linked with green consumers and the technologies that has lesser environmental impact; Shove (2003) suggests that instead one looks to how new conventions become normal, and how that affects sustainability. Shove (2003) touches on three domains – Comfort, Cleanliness and Convenience. Shove argues that there is more to the consumption applicable to any domain, the consumption itself, like space heating and water heating, makes up for the largest use of domestic energy.

Though Shove (2003) primarily writes about energy and water consumption as something invisible that consumers ignore, I reason that this can be applied to plastic as well – and had it not been for the latest uprising against, plastics in the oceans, plastic in our food and microplastics in general, the consumption of plastic could have remained invisible. The Danish foundation for Nature Preserve, Dansk NaturfredningsForening, completed a project in 2021 regarding counting and sorting single-use packaging in households over a period. Bringing awareness to a largely invisible product.

Applying the three domains in the use of plastic, Comfort, Cleanliness and Convenience. One of arguments dealt by plastic lobbying is that it supports the well-being tied to conveniences such as reduced spoiling, time-savers, and guaranteed cleanliness (often in relation to medicine or hygienic products).

Research regarding food waste suggests that 25% of Danish consumers aim directly for products that have plastic packaging, rather than non-packaging goods. Thus, a non-insignificant part of the population prefers what value the plastic packaging has to their consumption.

The link between consumption and convenience can be somewhat difficult to equate directly – since the reasoning of the individual might be different, the consumption happens regardless of conjecture. But packaging is only a cog, in a massive system of decentralized consumption, predicated from a centralized production. It is a central function of it being possible, customers and their comfortability in fresh produce of all kinds on an all-year basis, are unlikely to go back to Danish winters, where the most vegetables available would be roots like carrots and turnips, and fruits would be largely non-existent.

As for cleanliness, I will touch upon a solution later, presented by the company LØS Market in Denmark that runs a packaging-free grocery in the center of Copenhagen. The concept revolves around consumers bringing their own packaging or containers. This has resulted in a few complaints

when it comes to them taking home dry-foods that spoil before the prescribed last date on the shelf. This can be caused by unsanitary containers - and the non-vacuumed product being exposed to elements and thus spoiling prematurely. This again reverts back to a convenience issue, that the consumer is responsible for the cleanliness of their container and/or packaging, and not the grocer.

Shove (2003) also touches briefly on the issue of convenience, that while searching to apply more free-time to individuals through convenient market products, it then amplifies the need for entertainment or pass-time consumption in that freed up time. And that the free-time is not healthier for us, as people feel more stressed in their desire to free up more time, from the period of 1965 to 1985. (Shove, 2003)

The systems themselves are widely connected to what we identify as the western standardization of well-being, and we are sadly escalating that consumption. For this project the theory proposed by Shove, will be applied to plastic packaging and the solutions proposed by Danish innovative businesses. And whether you increase or decrease comfort, convenience and/or cleanliness from the European standardization, or if you can in some way halt the escalation of package use.

The theory regarding practices and practice changing will largely be used to determine if a solution or practice change will be possible through the scope of a social backlash from a socially sustainable viewpoint.

3.4 THEORY ON CIRCULAR ECONOMY – CLOSING THE LOOP

Consumption of goods exist on a linear model, in which resources are extracted, refined for consumption, and then dispose of the product once it has served its purpose. Which, in turn wastes material resources, which in Denmark is often incinerated or sometimes placed in landfills.

The loss of resources increasingly effects member states of the European Union who has to import vast amount of resources to produce and facilitate consumption goods. Meaning that new ways that circulate produce would accommodate a reduced use of virgin materials and avoid spending vast sums to import otherwise expensive materials from abroad. (European Union, 2016)

One of the major issues with plastic packaging is that it has a very low lifetime – with single-use packaging often serving even less than 1 year, before it is disposed of, with volumes of 40% of all plastic use in 2017 (Mckinsey, 2019) – therefore implementing circular strategies in relation to plastic packaging have a chance of optimizing the lifetime of a product. (Geyer et. al., 2017)

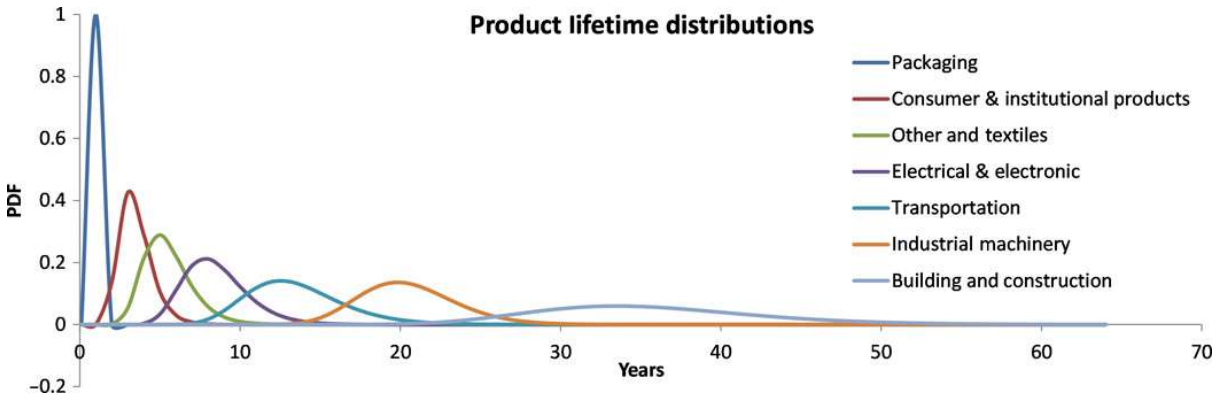


Figure 10 – Product lifetime distributions for the eight industrial use sectors plotted as log-normal probability distribution functions (PDF), (Geyer et. al, 2017)

In figure 11 below is a representation of a circular system, known as the butterfly diagram. It illustrates a continuous flow of materials in a circular system. Each colour, blue and green respectively, represents the technological cycle and the biological cycle. The system suggests that the technical side should rely upon reused materials, and natural resources, where as the biological side covers reusable resources that enter the circular system. (Konietzko et. al., 2020).

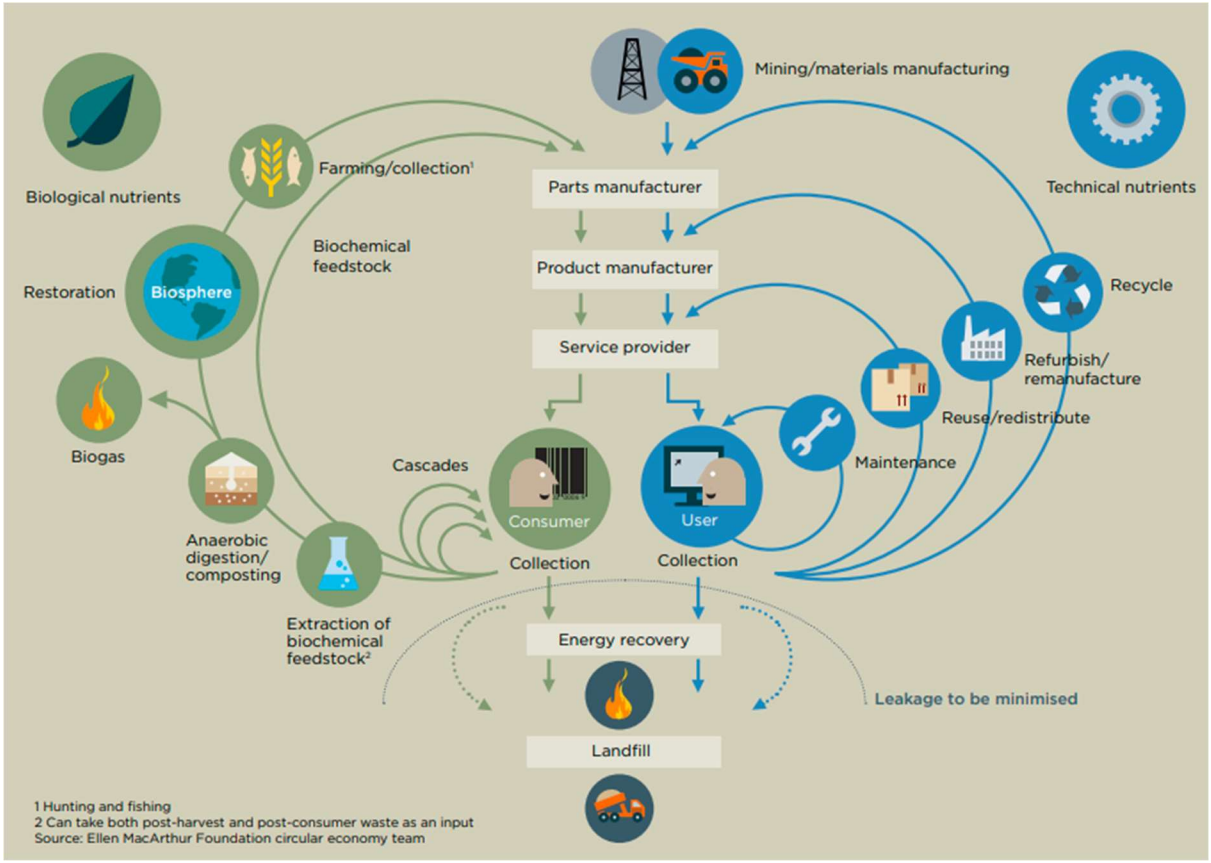


Figure 11 – Ellen Macarthur Foundation representation of circular economy – also known as the butterfly model (Ellen Macarthur Foundation, n.d.)

3.4.1 CIRCULAR STRATEGIES

There are five different circular strategies, each of which are interrelated (See figure 12 below). Narrowing, Slowing, Closing, Regenerative, and Informing.

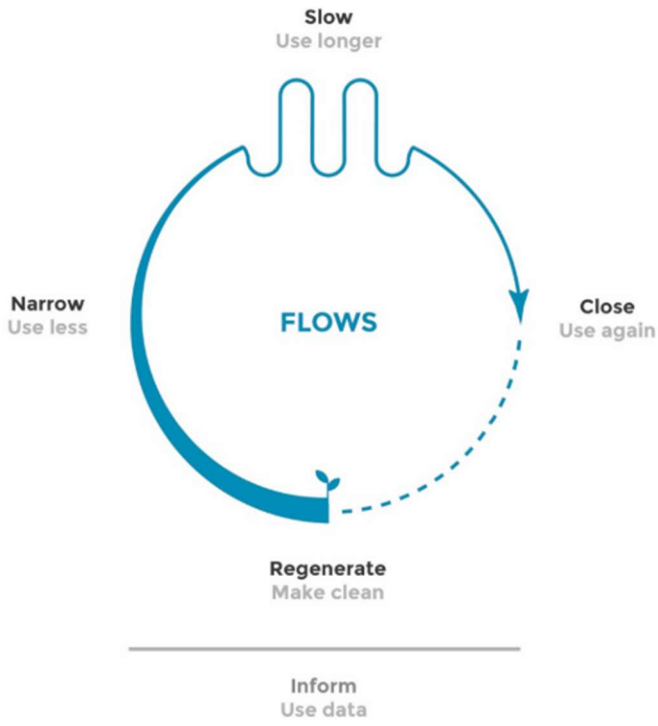


Figure 12 – Five circular strategies (Konietzko et. al. 2017)

Narrowing describes the act of using less material in the design and production phase of a product. In terms of plastic packaging, previous examples feature thinner and less dense material, getting the same effectiveness with less. Unfortunately, these products ends up often more contaminated or damaged, making them harder to regenerate or use again.

Slowing describes the act of slowing down the degradation of the product extensively increasing its lifetime, either by renting or making the durable. Plastic packaging already has atrociously short lifetimes, as it is often consumed within a year (See figure 10 above).

Closing describes the act of consumers returning their waste product back into the economic cycle. In terms of plastic packaging a known example is that of returned drink bottles to a deposit scheme where you are paid back for every bottle you return. Designs that are easier to take apart or used again are key element in this strategy. It also covers the design of plastic packaging that is able to return into recycling.

Regenerative is primarily a topic reserved for renewable energy, though especially for plastic packaging it points to using renewable resources to create the same effect, by creating bioplastics made from renewable resources in sustainable practices.

Informing describes the use of information to support strategies for circular economy. Campaigns like “Plastic is fantastic” shows Danish Celebrity Linse Kessler use a deposit scheme for used drinking bottles, and other information technology to spread the need for sustainable solutions can help. Featuring in this study is Danish Preservation Association who uses information to lobby on the side of nature preservation and sustainable living.

3.5 METHODOLOGY – SUSTAINABILITY

What is Sustainability? Most might be familiar with the quote about what sustainability is from the Brundtland Report 'Our Common Future' of 1987

'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

(Brundtland, 1987)

Brundtland (1987) goes on to identify three pillars of sustainability, economic, social, and environmental sustainability. Each of which must be met to create a sustainable solution. In the case of primary plastic packaging, one of the key modern issues of sustainable plastic production relates to the fact that plastic packaging currently does not offer a sustainable solution (Bruijnes et. al., 2020).

While a disputed issue, a study conducted by the sustainability charity Wrap found that plastic packaging helped increase food waste, since consumers would buy more than they needed. The only increase in food shelf-life seemed to stem from refrigeration (Wood, 2022).

Environmental sustainability is the responsibility to conserve natural resources and protect global ecosystems to support health and wellbeing, now and in the future. And plastic packaging has threatened waterborne ecosystems, by ways of micro-plastic– that lately have begun invading human bloodstreams (Carrington, 2022). And without save ways to handle some types of plastic a lot of it gets dumped in the environment instead. Of plastic found in bloodstreams almost half was from PET, a common usage for drink bottles, a third contained polystyrene, used mainly for food packaging, and polyethylene for plastic carrier bags. Plastic is contaminating the environment and us as humans. Therefore, plastic itself can be a hard sell for an environmentally sustainable solution. Other factors play in once you rid yourself of plastic packaging, and these have to be outweighed by the damages that current plastic packaging practice use, to retain sustainable credentials.

One element of social sustainability is portrayed by chapter 3.4 and relates to the idea that future generations have the same level of (or better) access to convenient and comfortable lives as our generation. The chapter begs the question of comfort, convenience, and cleanliness, and how they serve in escalating and standardizing our ways of consumption. A new type of solution should therefore not escalate our consumption from an environmental aspect but should neither try to disrupt the current state that people lose out on goods they already have access to. As mentioned

earlier, even non-packaging advocates like LØS Market recognize that customers would not accept only having access to locally grown produce.

Economic sustainability similarly benefits non-disruptive premises that would disrupt the inner market of the European Union. While disruption can cause innovation, a total abandonment of existing practices would likely lead to Brexit-like panic, with similar ramifications of empty shelves and a disproportionate 'grow-it-ourselves' culture that will take years to develop or make sustainable technologies to sustain such a transition. Backlash from the industry is not wanted when making new solutions. They, like their consumers, benefit immensely from the timesaving provided by their packaging and technology systems.

3.6 METHODOLOGY OF LITERATURE REVIEW

In the report the primary use of literature has been to establish the current state of plastic packaging and understanding the difficulties associated with changing or disposing of plastic packaging, both as a manner of waste, but also as a manner of pre-packing produce. The contribution of literature to the report falls within 3 types of literature - Documents, Research Papers, Data

3.6.1 DOCUMENT ANALYSIS

Document Analysis primarily is used to denote or understand actors' perspectives with official documents and articles presenting an actor and their relationship to the packaging problem. Government documents are also largely necessary to provide data that does not exist in the raw form as might be found on Danish statistics databases.

Similarly, the analysis provides access to innovative ideas for packaging-free solutions or exchanging plastic packaging with other types of plastic packaging. Though if possible, the solution should be examined through interviews wherever possible.

3.6.2 DATA SOURCES

Primary source for this is Danish statistical databases that are open to public scrutiny. This site provides a large amount of data necessary to understand the development of amounts of waste, changes in industrial structures, and other systemic changes that might affect behavior related to shopping.

Other data is collected from Document Analysis or Published Research to cover specific inquiries, such as behavioral studies.

3.7 METHODOLOGY OF INTERVIEWS

Interviews will be conducted primarily in a semi-structured manner to allow for open dialogue on the topic at hand, not restrained by the interviewers understanding of the topic at hand, and allowing the interviewees expertise to naturally bubble to the surface and unique information to partake - following people have been contacted for interviews.

3.7.1 DANSK NATURFREDNINGSFORENING - SOFIE HVENOM

Dansk Naturfredningsforening abbreviated DN (Danish Nature Conservation Association) is a resource for green and environmentally friendly initiatives within Denmark, focusing on pushing the environmental narrative and increasing the responsibility of state, business, and citizens alike, towards the environment.

They are interviewed largely for their expertise, knowing Danish examples of non-packaging or reuse packaging solutions, as well as pushing for policy changes within government. Interview is focused on establishing what changes need to be made to legislation, wider logistic systems, and behavior to support reuse/non-packaging initiatives. Documents provided by DN have also shown similarities in barriers facing transitioning, such as the publication: State of Sustainable Packaging.

Sofie Hvenom will be interviewed for 30 - 45 minutes, explaining current and future initiatives, as well as some of the barriers facing transitioning towards reuse packaging.

3.7.2 LØS MARKET

LØS Market was not officially interviewed but was paid a visit to their store in Nordre Frihavnsgade, in inner Copenhagen. The purpose of this visit was to get a feel for how the store operated, as one of the famous non-packaging minimarkets within Copenhagen, and their relationship with some of the issues often raised when it comes to non-packaging dry/wet foods, domestic products, and vegetables.

The visit yielded a constructive platform for driving a non-packaging grocer business. Philosophy is noted to be similar to Censuum, who runs a modern environmentally friendly small-scale mall, where customes can buy clothing from recycled or refurbished materials, and environmentally friendly cosmetic products.

3.8 METHODOLOGY CASE ANALYSIS

The analysis seeks to define the solutions and what they offer in terms of multi-level perspective, that allows or disallows innovation regarding packaging. The first basic understanding is to understand the EU definition of packaging, which features in the EU-directive for packaging and packaging waste:

"'packaging' shall mean all products made of any materials of any nature to be used for the containment, protection, handling, delivery, and presentation of goods, from raw materials to processed goods, from the producer to the user or the consumer. 'Non-returnable' items used for the same purposes shall also be considered to constitute packaging." – EU parliament (1994)

A more specific line then establishes the differences between primary, secondary, and tertiary plastics. Primary being actual sales packaging, like a plastic bottle for a soda, secondary plastic, as the plastic wrapped around said soda bottle to guarantee a purchase of more than one bottle, and finally tertiary plastic which covers the plastic used in transportation and logistics.

The network surrounding this is much harder to define – though the directive clearly defines that packaging which is placed on the market within the Community is considered covered by the directive, the terms of where to place the responsibility should then rightfully be the actor that places said packaging on the market.

3.8.1 THE CRITERIA FOR SUSTAINABLE INNOVATION

As established in Chapter 3.1 Theory of Multi-level perspective, the elements of system innovation are as follows.

- They involve co-evolution of a number of related elements;
- They involve changes in the supply side (e.g. technology, knowledge, industry structures) and the demand side (user preferences, cultural meaning, infrastructure);
- They involve a wide range of actors;
- They are long-term processes (evolving over decades). This presents challenges for effective and consistent policy interventions over political timescales, and also for the analysis of ongoing transitions under policy interventions.

It is duly noted that the elements should not try to stray from sustainable innovations. Below each of the elements are laid out, in determining how each solution should be analyzed.

Likewise, the solutions should offer some responses to the barriers established by The State of Sustainable Packaging (see table above & 2.4 Plastic Packaging). Some of these barriers remain interwoven with Geels (2006) criteria for system innovation and Shove (2003).

3.8.2 CO-EVOLUTION OF RELATED ELEMENTS

When discussing co-evolution of related elements of packaging - it is examining the previous system we are trying to replace, what we replace it with and if the related elements are able to innovate with the changes. The main barriers operating here, is whether sudden changes can accommodate the product the packaging is used for, along with design choices that are not aimed at recycling or reuse. Reuse is similarly disadvantaged by the barriers set as it does not offer complete closing of the loop.

I reason that while closing the loop is vital to create sustainable packaging; that moving towards collection schemes still offer better returns than recycling, as it, amongst others, keeps contaminants that might be found in non-food packaging away from food-grade plastics. Therefore, while the barrier of full closed loop is currently not possible with reuse schemes, they shall still be considered a movement upwards in the EU waste hierarchy, and thus a positive aspect of an innovation.

In this report I will cover some of the efforts to move towards standardized cosmetics products, that addresses some of the more niche barriers that deal with the marketing and branding barriers that

might occur when releasing a product. New Loop has similarly had their collaborators claim their reusable packaging as their own, in a marketing effort.

3.8.3 SUPPLY AND DEMAND

Supply and demand cover a wide spectrum of changes that must happen in the innovation. The main barriers presented relate to a whole slew of issues ranging from design of packaging, which include material choices and marketing potentials, to customer preferences related to consumer practices related to Shove (2003). This touches upon some of the collection schemes as well, as mentioned earlier, Danes have a familiarity or cultural reference with reuse and collection schemes related to plastic bottles. This means that Danes can be motivated by giving value to packaging, the most successful collection or reuse schemes of Danish markets boasts an above 90% rate. Giving ownership to the packaging product creates responsibility and value to it.

Whether the value given then outweighs the convenience, comfort, or cleanliness of just not dealing with packaging, is still an issue related to these collection schemes. Therefore, a packaging product can not merely mimic existing systems without addressing the experience of the packing in handling it. This problem exists similarly in other waste handling, where mixed packaging offers frustration of separating the packaging pieces.

3.8.4 WIDE RANGE OF ACTORS

An actor is according to Latour, something which is granted activity and agency, by its own existence. Normally when discussing actors, we are reliant on thinking of human actors, though non-human actors, such as research objects or technical infrastructures, thus this seep into the second element of supply and demand. The wide range of actors is needed to facilitate a foundation that actively replaces existing system practices, rather than just filling an already existing gap or customer group.

In case with packaging the range of actors' points towards the companies that place packaging on the market that is undertaking a system innovation, and the surrounding actors that help facilitate that.

3.8.5 LONG-TERM PROCESS AND POLICY

The long-term process and policy in relation to packaging leans towards not making an innovation that later comes to be changed. The most common of these issues in Denmark today, relates to measuring water consumption, primarily in rented apartments. The issue that an investment might be overturned by a future political decision can therefore interfere (Both negatively and positively),

the innovation should therefore also in some form follow or help create political incentive. In current terms most political parties are pushing for regulation on packaging and getting on the wrong side of regulation could squander investment.

In this report I take into account that the producer responsible for packaging regulation is not yet complete, meaning we do not yet know the economic ramifications that it would have on any specific innovative idea presented below, we do however know that the current negotiations relate to which companies should face exemption and in what degree for their efforts. So instead, I shall aim to evaluate, if a case can be made for the innovator's reduction in environmental impact.

3.8.6 EVALUATION AND PROGRESS

The evaluation and possible progress that can be made with a given packaging solution, what are the advantages and disadvantages listed and what barriers are still necessary to overcome? While some questions hinge on market acceptance, as well as adaptation from the public, it should remain clear which of the barriers are not being addressed by the innovation, and what could be done to address them.

CHAPTER 4: ANALYSIS

This part of the analysis will examine three different Danish examples of innovative solutions to plastic packaging.

- LØS Market – a small grocery company with two stores in central Copenhagen using non-packaging strategies.
- New Loop – an innovation company focusing on reuse scheme take-away boxes.
- Purely Professional – A cosmetic company with a reuse shampoo bottle and non-packaging scheme.

Including the French governments ban on Plastic packaging on fresh fruit and vegetables.

4.1 LØS MARKET

LØS Market is mentioned a lot before in this report and covers 2 grocery stores in inner Copenhagen. The stores sell grocery goods with the explicit goal of minimizing plastic-packaging throughout its value chain. Which it has managed to solve almost entirely, with a few exceptions as long-range goods such as rice, can spoil outside of plastic protected environments.

The grocery market sells primarily fruit & vegetables, a selection of dry foods, coffee & tea, detergents, juice, and fresh produce (such as eggs). In essence making up the combination of a 1950s grocery in the center of Copenhagen, but with a modern focus on packaging reduction and the complete removal of single-use packaging from the stores.

4.1.1 CO-EVOLUTION OF ELEMENTS

The grocery idea is not as much as co-evolution of elements as it is a look back to a time where consumption was more centralized, and you shopped at your nearby stores, rather than use a car to travel far for shopping. The modern idea of the supermarket is not quite conceived yet, within Denmark at this point and thus you would have grocers, butcher, green grocers, fishmongers, and other local stores to provide you with the consumption goods you needed at a local store.

City planning up to the 1970s was similarly posed with this idea, the area of Tingbjerg was made as a self-sufficient city, in the sense that you would never have to leave the comfortable confines of your neighborhood for any shopping goods.

The reliance on pushing for a similar system would require a wide array of smaller stores that cover the consumer goods that you cannot get at LØS Market. Goods that you might find in a local

supermarket instead (One major nearby competitor being Føtex). This however might prove difficult. In Denmark there is a current decline of small stores, in favour of discount stores. (See figure 13 below).

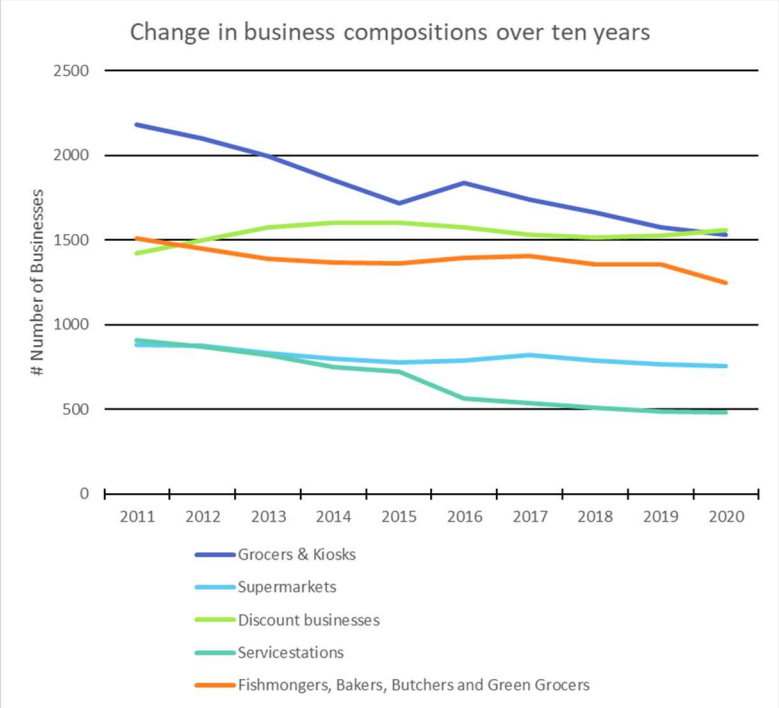


Figure 13 – ***Changes in Danish business composition over a ten-year period (Data source: ERVH1 Danish Statistics, 2020)***

ICP A/S in collaboration with Realdania proposed this trend already back in 2017, where the changes of Danish law benefitted larger supermarkets to allow them opening hours during weekends regardless of their size and gross income (ICP A/S, 2017). Notably ICP A/S found that from 1998 to 2016, following trends have favored local discount stores way more, halving the development of supermarkets in favor of an increase of 150% more discount stores. Meaning that allies and other collaborators might be harder to find.

The Store does not directly deal with closing the loop as much as it avoids the loop entirely. Reusing painted glass bottles for any fluid consumer good and big green reusable plastic crates for deliveries with WOLT. This as a business case has also opened a market that previously did not exist during the Covid-19 pandemic, to meet with declining customers in stores.

From a purely environmental standpoint the replacing of an existing system seems to benefit from the expulsion of single-use plastic, with the ability to buy recipe specific amounts and avoid bulk-purchase that might spoil before consumption; this helps facilitate a reduction of food waste at the consumer end. Food that is about to expire is donated to a group called ‘Tyg og Tænk’ which is an event to reduce food waste.

4.1.2 SUPPLY AND DEMAND

What LØS Market does uniquely is that it offers a lifestyle choice that allows you to live without packaging. A sort of contra-response to the idea the argument fielded earlier that:

"You cannot continue using current packaging methods, but you cannot abandon them either. After all, the intrinsically sustainable alternatives are not available yet."

(Brujnes et al., 2020)

One of the key elements of being able to sell goods this way is to make sure that the product meets with legislation demands for the product. Often meaning it needs a sell-by-date (Experingdate) and a handling method that offers no contamination risks. To this end a mechanical plastic dispenser was conceptualized by owner Frederic Hamburger.

The dispenser technology is mechanically designed and relates in large part to other similar dispenser technologies facilitated by other non-packaging schemes like Algramo in Chile. The dispenser is mechanically operated, and the system ensures the product sold is from the earliest expiration date, and that products of varying expiration do not mix when handled. The packaging brought by the customer is weighed and given a print of a label that dictates the weight of the packaging and saves it for later during checkout. The streamlining of this system helps speed the process along.

The process is however clashing with the aspect of convenience, as it requires consumers to bring their own packaging, and the effort is shifted onto them for delivering the cleanliness, that guarantees pristine conditions for their product. While LØS Market operates with reuse for oils, juice and detergents, any dry product and vegetable relies on the consumers own packaging.

It is in a way a shift of hats – Customers are relied upon for the cleanliness and convenience of their packaging but have an active say in how much product they buy, meaning that the store itself can oversee food waste responsibilities. By shifting these around there might be enough disruption possible to change practices and habits, but this might take some time to get used to, as the hats switch around again should the consumer visit a supermarket or discount store.

4.1.3 RANGE OF ACTORS

LØS Market is a single independent actor in a market with no shareholders. This means largely that the power to do so depends on their customers and their own demand for their power relationship with their suppliers but offers a very simplistic type of value chain. It does however also allow the company an autonomy to engage with other interests group on a local scale without overreach from a large stakeholder above them.

Table 2 - *LØS Market*

Company/Institution	LØS Market
Network-type	Independent Grocery with allies and suppliers
Innovation	Non-packaging Grocery
Allies or collaborators	WOLT (Delivery Company) U-Kirke - Tyg og Tænk (Food Waste reduction) Sociale Saxogade and Cafe Sonja (Social Settlement) Juicy Istedgade (Cafe)
Power Foundation	Social and Environmental-aligned responsibility with current consumer demand for less packaging.

Initiatives taken on by the company allows them to focus on social and environmental messages and the localized efforts. Allies such as social settlement and Juicy Istedgade benefit from unsold produce for food and juice production, offering more sustainable practices of food waste.

This does not exempt them from driving an economically sustainable business. And measures during Covid-19 lockdowns had to be taken, following the footsteps of other grocery delivery services, and hiring WOLT to deal with transport of their goods to their clients.

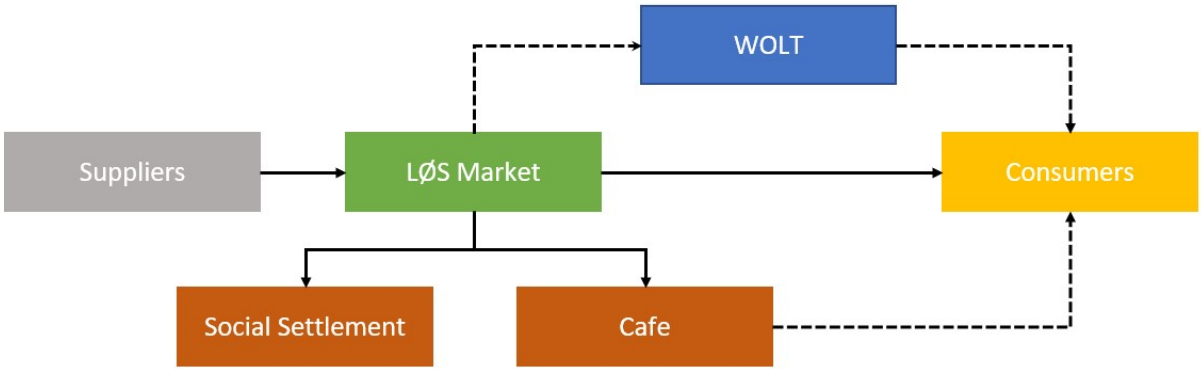


Figure 14 –LØS Market Value Chain

The company engages a wide range of actors, and actively seeks to create a better local consumption of goods – though it has some struggles, only applying to an already narrow group of individuals dedicated to avoiding plastic packaging, which narrows down to roughly 20% of consumers according to Consumer Food Waste in Denmark (Stancu & Lähteenmäki, 2018).

4.1.4 LONG-TERM PROCESSES AND POLICY

There are no national laws directly guaranteeing the security of smaller businesses, but municipalities like Aarhus and Copenhagen have been running initiatives to help for small or medium-sized companies, through networking, digital setups and other requirements needed to run a business.

And while there is no ambition to run complete packaging free solutions, risking pushback from the retailing sector and the economic inner market of the EU, the grocery tears out all the barriers mentioned earlier, deciding to deal with plastic packaging, by not dealing with it at all. It might be that in the future this has a economic benefit, after the implementation of the packaging responsibility, since the company has developed a strategy that almost effectively removes the amount of packaging waste from their business, meaning that the strategy would have an edge over conventional plastic packaging in discount stores. This remains however to be seen, and if it has long-term effects on the innovation type.

4.1.5 EVALUATION AND PROGRESS

LØS Market is a very direct response to the issue of plastic packaging, and the need for social and environmental sustainability. Though very experimental in its nature, it offers an honest solution to the plastic packaging – the ingenious mechanical system of the dispensers rivals the more technological version of Al Gramo's dispensers. It delivers a unique perspective of what a modern version of the grocery can look like, with social and environmental responsibility.

It allows for the free choice to avoid plastic packaging in a small scale operation

BARRIERS

Generally, LØS Market does dispense entirely with the barriers, in favor of the current desire to dispose of them by public reckoning. In that sense neither the packaging itself, nor plastics circularity is an issue.

The company's minimal use of plastic might hint, that simply disposing or changing to paper, not will provide the same comforts and conveniences as plastic, but argued that this is a necessary step for sustainable grocery in the future.

SUSTAINABILITY

Presented with the definition of Sustainability, LØS Market raises the level of the EU waste hierarchy up to prevention of plastic waste, though it does replace some packaging with paper bags when selling flour or sugar, it moves in a manner that benefits the environment by reducing food waste and packaging, while also benefitting social interests.

FUTURE GOALS

There is an urgent need for long-term learning of how to shop differently than usual, focusing on what consumers might need rather than continued bulk-buy or bulk-buy sizes for the past.

A lot of intertwining between products, that programs consumers to shop in a particular way. This would require time to unlearn shopping in certain sizes or weight in a way one was previously used to. Products of freeze-fried mix to make family dishes cater to specific size of bulk-buy that exist across supermarket stores, and programs us to think of portion sizes in this way. Dictating the recipes for us as we shop.

LØS Market is liberating in this sense, but without the same market control, it does become vulnerable economically towards other big chains that continue to influence its users. This might be solved by economic changes to the new Danish legislation on plastic packaging, where LØS Markets missing plastic will allow it a market advantage, where prices can be kept lower than competitors. This however remains to be seen.

4.2 NEW LOOP

New Loop is a take-away packaging reuse scheme, made in collaboration with German Jokey Group, a plastic manufacturing business. Their main business model revolves creating a value-chain that reaches from the start of production, all the way through handling and reuse scheme (See figure 15 below). This is done in such a way that the take-away packaging is followed throughout the system and makes it easier to monitor and optimize the packaging. The goal of which is to see a return rate of 50% by 2023.

New Loop is owned by major shareholders such as WOLT and Letz Sushi.

4.2.1 CO-EVOLUTION OF ELEMENTS

As a level of co-evolution of the elements, trying to reach beyond the entire structure of a value chain, allows for innovation on a large scale.

Originally take-away places have mainly been independent, with some being tied into franchises that allows for independence. This meant in large part that it was up to the individual take-away place, which kind of packaging they would use, if they would have a delivery service and the range of that delivery service.

With the digitalization of take-away, it has suddenly become possible to network many previously independent businesses, with one another. WOLT, Just-eat and Hungry were such companies who tried to streamline access, exposure, payment. and delivery process for the take-away businesses.

New Loop is another step on this path, as their major shareholder WOLT is currently experimenting on replacing take-away packaging in Copenhagen, with New Loops system. This is a much smoother transitioning that disposing of all packaging and offers a larger scale operation than something like LØS Market does, however it also infringes on the user differently as it means shopping with WOLT immediately requires you to handle the reuse scheme.

4.2.2 SUPPLY AND DEMAND

As mentioned just above, there is a clear sense that the entire supply structure is reached over by New Loop and its collaborator German Jokey Group. Whether demand however is fully justified can be defined entirely what angle you choose to take on the packaging. Because it is true that consumers when given a choice, would often go for convenience. But in this system, there is no choice. Shopping with WOLT and its take-away business partners will require the consumer to use

the scheme in a similar fashion to how a consumer that want to sample any of the products listed in 2.5 Summary, are being pushed to use the return scheme by Dansk Retursystem.

On one hand this has a major advantage, if people are without a choice and value is placed on the packaging, they will be compelled to return it and use it – if they want to shop and dine from a take-away place that features the reusable packaging. On the other hand, it clashes with the convenience and the cleanliness of previous products.

Low effort convenience and cleanliness will tell any citizen to dispose of anything messy or disgusting as waste. This has been found the issue with basic recyclability before, where consumers are wanton to dispose of recyclable objects that are messy in their residual waste rather than recycling. Anyone that has ever ordered take-away will note that not all packaging remain clean during transport and offer a greasy feel to the packaging afterwards.

This once again relates back to the issue found with the cleanliness by the bottle return scheme run by Dansk Retursystem, that sticky and wet handling of bottles made for more maintenance and discomfort from the users. Newest optimizations that handles the bottles without risk of getting greased by the packaging product have pushed away from that, where as New Loop might face similar trouble, should it ask consumers to handle the packaging in a similar fashion.

4.2.3 ACTORS

New Loop has actors involved on the entire value chain, from the Producer (Producent on the figure x below) named German Jokey Group, to take away restaurants, either involved with WOLT or as an independent shareholder, to the consumer, and then back to Dansk Mobil Opvask (A reuse return scheme for, which is another reuse and return scheme for cups, glass, and cans. Once cleaned it is returned to the take-away restaurant unless it is damaged, where upon it is recycled again.

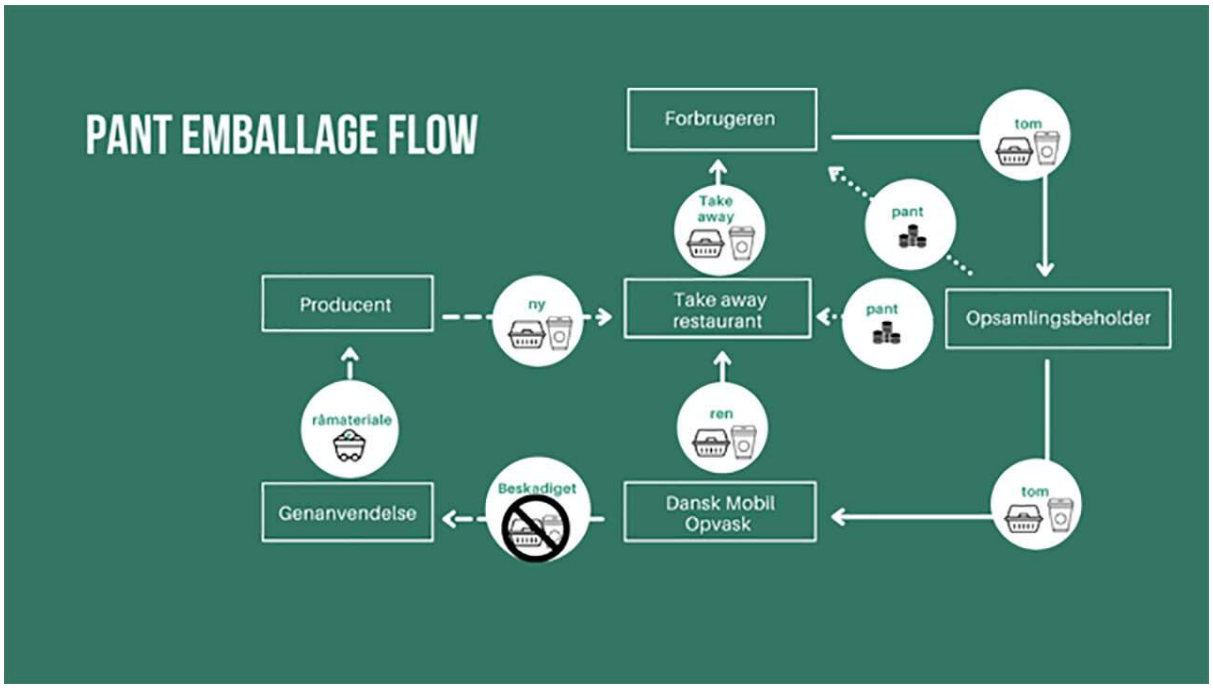


Figure 15 – ***New Loop value chain***

The actors involved beyond this are groups other than take-away restaurants that still enjoy New Loops services, and government and governance interest, with both Bornholm Municipality through its ZeroWaste policy and Ministry of Environmental affairs being keen on the idea to introduce circularity to take-away.

As such New Loop spans a wider and more complex actor network, going beyond the local scale. While on purely experimental stage, the system is wide reaching, and answers a common trend in modern society. While take-away and other products are not as prevalent as wanting fresh produce, with 60% of interviewed Danes answer that they eat homemade dinners at least 5 times a week (Stancu & Lähteenmäki, 2018).

Table 3 – *New Loop*

Company/Institution	New Loop
Network-type	Reuse scheme for Take-away
Innovation	Entire revitalized system to bring down plastic waste in Take-away
Allies or collaborators	German Jokey Group (Plastic Producing company) WOLT (Delivery Company) Letz Sushi (Take-away company) Dansk Mobil Vask (Rental and Dishwashing company)
Power Foundation	Value-chain wide control and optimization prospect. Allowing for full-scale

4.2.4 LONG-TERM PROCESS AND POLICY

Take-away is no small waste making industry – In 2018 a survey concluded that of all plastic waste collected in Copenhagen alone, half of it was PET food packaging, which amounts to 300 tons of plastic waste that ends up in public space waste bins every year (Qureshi, 2022).

Similar Polypropylene cups when used at least 2.7 times, offered lower climate impact, and Copenhagen would attempt shifting towards reusable cups at their own events as well as push for events held in public to do so also (Qureshi, 2022).

This means that the City of Copenhagen wanted to push for a system innovation that New Loop (or their collaborator Dansk Mobil Vask) packaging can solve, providing ample opportunity for New Loop to create long-term changes to the landscape of cities that are willing to make the transition away from incumbent plastic waste, that is tied to the take-away business.

4.2.5 EVALUATION AND PROGRESS

New Loop offers a control of an entire value chain, making it able to monitor and make decisions without interference from the outside.

BARRIERS

New Loop deals with the barriers presented in the State of Sustainable Packaging head on, taking a lot of inspiration from the circularity issues that might arise when creating a system like this. Though the main concern that is somewhat skipped is regarding the return rate and how that affects the circularity. Currently New Loop only boasts a goal of reaching 50% return rate by 2023, a short-interim goal, that requires long-term adaptation to break with the convenience and cleanliness factors of handling the take-away packaging.

Knowing and accepting this however – by setting realistic goals for their return rate, puts New Loop with some advantage over more ambitious goals that might fall short by the changes in practice needed along the way.

SUSTAINABILITY

With complete control of the value chain, there is some expectations regarding a sustainable production. As of yet, I have not been able to determine whether the take-away boxes are simply disposed of in Denmark as plastic waste, and through German Jokey Group buying recycled plastic to create new take-away boxes from. Or if the take-away boxes that are damaged are sent directly back to German Jokey Group to be repurposed into new take-away boxes.

This plays a crucial role of how to understand the sustainability, as previous take-away boxes that are contaminated with other plastic products can lead to downcycling of the food grade plastic used for the take-away boxes, while improving on an existing pitfall, falling inevitably into another.

Adding another layer of consumer handling have also added to the skepticism of this product. DN concluded this year, that a lot of coffee cups and plastic bottles were found across Denmark on their annual clean-up event. While these coffee cups could be replaced by New Loop, there is no guarantee for these to be returned even when given value, though it must be said that the number of bottles found in Copenhagen was increasingly low compared to coffee cups. Whereas in Southern Jutland the number of bottles left about were larger than coffee cups, suggesting that the product will have varying degrees of effectiveness in inner city centers.

FUTURE GOALS

New Loop must reach their goals of return rates as quickly as possible, while giving value to their product in the mind of their consumers, that it overcomes the cleanliness and convenience of returning them for reuse – without a proper regeneration of the packaging into new packaging, there is a risk of downcycling.

4.3 COSMETICS PACKAGING

There exists both French and Danish versions of cosmetics packaging, I will use the Danish example, Purely Professional, as the solution analyzed. However, as with French legislation seek to gain inspiration through what the French companies does different compared to the Danish model, and if it can offer anything to improving the Danish model.

4.3.1 CO-EVOLUTION OF ELEMENTS

One of the most important parts of cosmetic sector has been that its packaging has a high marketing value, which means that any single solution through an entire collection might be wasted effort as each material might offer completely different obstacles to changes.

Purely Professional dispenses with this original barrier, by considering environmental concerns prior to marketing effort. The company pushes for standardized packaging, refill stations of standardized packaging and non-packaging solutions like shampoo in brick form.

Figure 16 – ***Picture of refill station of Purely Professional Shampoo Collection (Purely Professional, N.d.)***

4.3.2 SUPPLY AND DEMAND

Like with LØS Market, the initial barrier related towards dispensers is related to meet with expiring dates and cleanliness. Purely Professional avoids this by dealing with three major concessions for refill.

1. All bottles able for refill will have this indicated by the packaging.
2. Bottles able for refill must be able to be sanitized with ethanol – Bottles are similarly expected to be rinsed with water before refill as a minimum.
3. Refill stations dispensers must have at least 6 months to expiring date, to ensure products can be used without risk.

Though this deal with cleanliness, the same issue LØS Market faces with convenience, in that people that pick their product must bring packaging to the store. Though Purely Professional has an advantage in that once consumers get used to the process of shopping like this, they are beholden to the product for a time, by buying the experience of at least one refill.

4.3.3 ACTORS

Purely professional have 8 refill stations located primarily in Copenhagen, Aarhus and Næstved. They are primarily apothecaries, though a single hairdresser and non-packaging grocer also offers refills of shampoo bottles (Purely Professional, n.d.).

About 250 distributors sell Purely Professionals products around Denmark (Purely Professional, n.d.).

Table 4 – ***Purely Professional***

Company/Institution	Purely Professional
Network-type	Refill and standardized packaging
Innovation	Refill of Shampoo bottles and non-
Allies or collaborators	6 Apothecaries in Copenhagen and Næstved Frisør Signatur (Hairdresser) Raa Aarhus (Non-packaging Grocer) 250 distributors across Denmark
Power Foundation	Social and Environmental-aligned responsibility with current consumer demand for less packaging. Product sells the experience.

4.3.4 LONG-TERM PROGRESS AND POLICY

Cosmetics is already one of the major battlegrounds of sustainable design (Srivastava, et. al. 2022). The definition of branding and design as the main marketing ability of cosmetics, to use a brand is to attain certain identity as can also be found in the fashion and clothing sector.

The advantage of standardized bottles presents itself when dealing with waste handling. As cosmetics are reliable contaminants towards recycling food grade plastic. The design allowing for proper rinsing allows a massive reduction of contaminants mixing with collected plastic, which by the time it is collected (hopefully) have been reused several times.

It must be kept in mind that like New Loop the cosmetic bottles risk creating downcycling, by using high quality food grade plastic for use in cosmetic packaging. An expanse of the network would perhaps see this come to an end with a return scheme when bottles are broken or damaged.

4.3.5 EVALUATION AND PROGRESS

Purely Professional prides itself on fulfilling, reduce, reuse, and recycle terms. On their webpage several initiatives point to their innovative solution, production of standardized cosmetic bottles from recycled plastic, reuse of those bottles, and reduction of plastic waste from shampoo bricks articles.

BARRIERS

The main barrier facing Purely Professional is that refill stations are few and far between, meaning that it might be more convenient to simply buy a new product and postpone refilling. This can easily be met by distributors like Raa Aarhus who are able to refill and exchange shampoo bottles for the convenience of consumers.

An experience would have more weight if experienced by the consumer, provided they must change their practices. But smaller changes like leaving it to a grocer might entice consumers that is not already convinced by the need to avoid excessive plastic consumption.

SUSTAINABILITY

Purely Professional has pushed for a sustainable practice, with understanding closing their own loop as well as possible. The issue is, as with previous reuse schemes that it only works if the level of convenience of refilling it does not go beyond the difficulty of throwing it out or give value to the packaging.

Since packaging design is crucial for branding in the cosmetics sector (Srivastava, et. al. 2022), the brand identity of Purely Professional must be sold on the ability of the identity that the brand offers. An environmentally sustainable solution for people that cares about their carbon footprint and plastic waste. That identity must weigh higher as it is consumers who finally makes the push for sustainable innovation (Srivastava, et. al. 2022). Thus, the convenience of using the product must co-relate to the effort that consumers are willing to put into this.

A centralized set of refilling stations does not act comparably with a decentralized consumption.

FUTURE GOALS

Moving to either decentralize the refilling stations, spreading them by pushing for more collaborators to have the refilling stations in their stores, or pushing for allies similar to Raa Aarhus to offer refilling services of their products with deliveries to ease the burden of convenience along with cleanliness.

Another could be to invest in mobile units akin to Algramos scooters mounted with dispensaries for detergent, to fill in locations that might otherwise be undermanned for refill proximity. Strategies involving how far people are willing to travel for similar services could further create logistic maps to furnish a system that can add to the experience of the product.

4.4 GOVERNMENT BAN ON PLASTIC PACKAGING ON FRESH PRODUCE

In January 2022 the French Government moved to ban single-use plastic packaging of 30 different types of fruit and vegetables, the first European government to push for such measures.

For vegetables the law concerned the following: *"[…] leeks, courgettes, aubergines, peppers, cucumbers, potatoes and carrots, round tomatoes, onions and turnips, cabbages, cauliflowers, squashes, parsnips, radishes, Jerusalem artichokes, and root vegetables."* (Euronews, 2021).

And fruits concerned: *"[…] apples, pears, oranges, kiwis, lemon, citrus, prunes, melon, pineapples, mango […]"* (Euronews, 2021).

The bill also proposes that all plastic packaging will be banned at latest from June 2026. (Euronews, 2021) a short interim goal, to reach complete elimination of plastic packaging on fruit and vegetables.

Non-surprisingly the pushback is mounting, especially from the food industry, with Interal arguing that the food waste will amount instead (Euronews, 2021), and French fruit sellers' federation president Francois Roch, suggested switching to cardboard would be difficult in short interim, adding

"Also, selling loose produce is complicated as many customers touch the fruit and people do not want their fruit to be touched by other customers,"

(De Clercq, 2021)

4.4.1 CO-EVOLUTION OF ELEMENTS

The legislation is by Brunjes, et. al (2020)s definition not producing co-evolutions of elements. Since it rather asks for the removal of key elements all together, expecting that if street corner vendors can sell produce without plastic, so can large corporations.

Though this pressure might create a pressure towards industries to innovate quickly, it does also not immediately stop the single-use plastic waste. Risk of turning a once visible plastic into invisible logistic plastic. Or even stop selling vegetables and fruits in small amounts that all are raised above the weight that allows supermarkets to sell in bulk with plastic still wrapped around it.

Underestimating the lengths that this may take the way we consume and the food waste that will be involved with bulk-buy if it is completely discouraged by new measures is somewhat dangerous path to take if the intent is to protect the environment.

4.4.2 SUPPLY AND DEMAND

When interest groups like Interal and French fruit sellers' federation goes out to meet this regulation head on, it is largely for fear of profits. Though Interal's comment in hindsight becomes invalid with new research pointing to bulk-buy consumption facilitated by plastic packaging does more harm to food waste than non-packaging solutions does. But it also points to the inefficiency that the ban might face on bulk-buy products, since fruit and vegetable are allowed to be plastic packaged if they reach a certain weight class. Meaning that bulk-buy of products will continue to create food waste in France even after the bill has passed. There is also a risk that cleanliness desires would drive people to bulk-buy plastic wrapped over single piece fruit and vegetables. And have a negative output on food waste in general. Though comments placed in response to Francois Roch, suggests that street market sales of fruit still is possible, but often more expensive than plastic wrapped products. Meaning that there might be a cost to bear from making this change on a consumer level.

Therefore, we might see early increases of food waste, unless there is a change in the way we perceive fruit and vegetables without plastic packaging, the worries of consumers rummaging through vegetables can indeed create an issue of cleanliness practices.

It is noteworthy however that similar practices in New Zealand created a boost in consumption of fruit and vegetables, some vegetables having notably increased consumption by 300% (Engbo, 2019). However, this is before COVID-19 pandemic set in which might have changed the perspective on fruit and vegetables.

4.4.3 ACTORS

Ambitious as the legislation are, there are some possible pitfalls to note. However, like with New Loop and the wide-range power of this legislation, pushing the envelope creates a system that changes the lives of consumers without a choice directly imposed on the consumers. To this end the French government has created massive changes similar to New Zealand, to dispose of single-use plastic in relation to fruit and vegetables.

Table 5 – *French Government Bill*

Company/Institution	French Government
Network-type	Legislation for Fruit and Vegetable Plastic (And take-away plastic) by 2026
Innovation	Remove 37% of plastic consumed through Fruit and Vegetables by banning the plastic packaging for Fruit and Vegetables.
Allies or collaborators	Unable to identify collaborators or allies, but issues has been raised by industry against the bill.
Power Foundation	Power invested by the people in Republic of France. The legal power to draft legislation that serves the interest of and responsibility for the French nation.

4.4.4 LONG-TERM PROCESS AND POLICY

The policy changes have been done with a growing concern for the environmental hazard that micro-plastic poses to the world. With full implementation for take-away as well as fruit and vegetable plastic entirely by 2026, the barrier of short interim goals with long-term consequences are repelled by the plastic industry, as noted by The State of Sustainable Packaging. The ripples throughout the value chain and the backlash from the EU inner markets might be noticeable, when produce outside of France must face likewise ability to be sold within the country, without discrimination of the product.

4.4.5 EVALUATION AND PROGRESS

The piece of legislation is massively ambitious and pushes for new strategies when handling fruit and vegetable on a large scale. And though it acts disruptively as is necessary for innovation, there is a hint of issues related to planning culture about it. The kind of issue that relates to one-way communication when dealing with the public, industries, or other non-government bodies. In that it creates resistance that might undermine the efforts of the innovation. Though an interesting 'last resort' to deal with plastic issues once and for all, it will ultimately fall by the wayside should the single-use packaging, be replaced by single-use plastic bags for people to put their fruit in instead.

BARRIERS

The most immediate barrier related to this piece of legislation is, that it subjects the industry to sudden changes, and thus breaks with the co-evolution of products needed to create an innovative system change. This is also why the pushback to this legislation might be found amongst industry more so than consumers.

SUSTAINABILITY

The policy is made with full acknowledgement of the environmentally sustainable issues at hand, causing large scale prevention of single-use plastic in a large sector of French consumption. The concerns issued by cleanliness, might cause a larger issue at hand, if the practice does not indeed change, and people will seek to buy larger amounts of plastic bulk-buy exempt from the legislation.

And while gradually practice change will happen when people have no choice to buy anything else, there must be changes. LØS Market had to change in how consumers buy and consume fresh produce entirely to reach these goals. If supermarkets and discount stores still manage to offer plastic bags for their grocery products this will not bring about the massive change that the French Government perhaps is looking for.

Unlike LØS Market's weighing system and policy, the individual store level of consumption does not offer a direct solution to problems when you dispel the plastic packaging regime and replace it with a non-packaging regime, instead just shifting practices that will retain the plastic consumption through other means.

FUTURE GOALS

The Government must together with industries come up with a solution to properly address how best to sell the products without single-use plastic packaging. The liberal inner market must adapt to the new situation that has been proposed to reduce their plastic consumption, but it should not do so entirely on its own, in such a way that loopholes are created that diminish the effect of the legislation.

4.5: PARTIAL CONCLUSION

Summarizing the need for innovative solutions, I have tackled four different solution attempts done in a variation of sectors, levels of involvement and with differentiating power structures for change. The idea is to find possible experiences to learn from the pitfalls made by individual designs that might not appeal to the consumer practices related to plastic.

Large structural changes clearly have the advantage, as often consumers are no longer liable to make the 'right choice', that in these changes, the choice is made for them. The implementation of which industry might revolt against in the long term as products with plastic packaging have become cheaper through a systematization of decentralized consumption, with centralized production. Plastic can help avoid contaminants with transport and as such do not require further handling steps after it has been packaged.

Both Purely Professional and New Loop has wide-reaching networks but do rely on collaborations between product developer and physical stores. This pushes consumers to repeat purchases within the same framework but does not necessarily benefit the consumer in doing so, asking them to make the effort of handling packaging responsibly.

LØS Market does remove packaging as well as the French Government, but also asks a change in behavior in the way we shop, to avoid the bulk-buy strategy and instead buy on actual consumption or 'how much do you use', as a healthier alternative by taking on the responsibility of food waste as a store, rather than the consumer having to dedicate themselves to eating bananas every day for the next three days, to avoid food waste. In a largely growing world with single living outpacing that of coupled living, buying small might in fact prove much more efficient to prevent food waste than ever before.

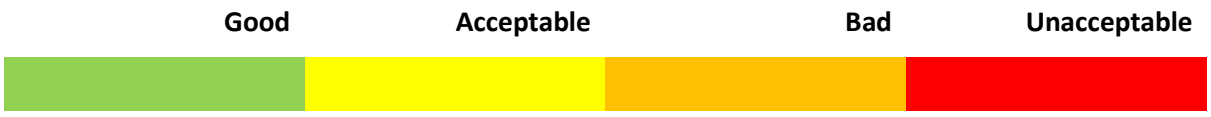
There is a large focus on environmental sustainability, and either economic or social sustainability to follow it. And while each system creates different solutions, all Danish systems seems dedicated to creating new ways to reduce plastic waste or reuse plastic resources. Though it is notable that most of these initiatives are largely centered on Copenhagen and Aarhus, with LØS Market and their similar competitor Raa Aarhus settled primarily on one of two cities. New Loop has scheduled rollouts in both cities as well, along with events reaching a little further to Bornholm. And Purely Professional have only two refill stations outside of Aarhus and Copenhagen, making up for 75% of the refill stations in these cities. We are reaching for low-hanging fruit in city centers while smaller towns and cities have no such choice to make and have to consume products with visible and invisible plastic with it.

France's response could become a solution to Danish consumer woes if plastic is not reigned in more carefully with the upcoming legislation on punishing producers, placing packaging on the Danish market that are not fit for recycling, though awareness should be put to products that only seemingly act circular. The concerns for the New Loops and Purely Professionals circularity hinges entirely on whether they will use their own plastic to create new bottles and boxes for their value chain, lest they use higher grade plastic downcycled to their ends, while their own products become only usable for pyrolysis. Even if in theory their products could attain circularity. And this would then in turn reflect poorly on the performance of sustainable plastic packaging in general.

Comparing the four together in the table 6 below is the graded values for each of the criterias they had to meet to create a sustainable system innovation.

Table 6 – Innovative solutions and their criteria, colorized

Innovation / Criteria	Co-evolution	Supply/ Demand	Actors	Policy	Sustainability
LØS Market					
New Loop					
Purely Professional					
Plastic Ban (France)					



CHAPTER 5: DISCUSSION

The Danish cases portrayed in this report does honest attempts at solving problems with the consumption of plastic packaging, with varying degrees of success. Learning from the limitation pushed on by the existing consumer practices is important because without these unique experimentations; we would never know the issues that fall within simply removing plastic packaging or trying to slow the consumption of plastic packaging with reuse systems instead.

The State of Sustainable Packaging offers a list of barriers that in some way must be overcome to create intrinsic packaging. We are not there yet. Though consumers are more aware than ever, the best some systems can do is tap into existing consumers that already avoids plastic packaging, or force new systems upon consumers that they might react negatively to. This is further emphasized by Stancu, V., & Lähteenmäki, L. (2018), which proposes that 55% of Danes are indifferent buying produce with or without plastic packaging.

Is the solution then to tap into those 55%, or push the 20% that wants nothing to do with plastic packaging, or the 25% that wants plastic packaging? The three cases tap into different parts of the Danish demographic, and might not bring about regime wide change, but create a niche, where people that want to make a difference, can make a difference.

The purpose of this study was to create examples of how creating system innovations for plastic packaging serves as better avenues for change than that of top-down government legislation that directly bans single-use plastic packaging, and instead initiate change through business and consumer practices.

While it is impossible to say on a short-term study if these niches will completely overtake and remake the technological regimes. They carry an immense value as laboratories of modern and responsible consumption. A long-term study would seek to implement or transfer the knowledge from these experiments onto actors that cover larger parts of the regimes. As experiments. In such a way that we can create a more sustainable solution.

None of these solutions will directly tap into the 55% of Danes who are content to continue unsustainable and linear consumption practices, either because there are no direct alternatives, with most solutions having foothold in Aarhus and Copenhagen – or because that it is not in their priority to do so. With a soon promised extended producer responsibility legislation in the works, however – it is important more than ever to have experiments that confer removal or reuse of plastic

packaging, that we do not end up in a stale environment, where we do not push for any innovation simply because it ‘cannot be done’ right now.

CHAPTER 6: CONCLUSION

The lesson learned by looking at these three Danish innovations and the French counterpart to removing all plastic packaging, is to make significant changes to existing regime Geels criteria needs to be met or the innovation will suffer from the shortcomings of not meeting them. The Danish innovations have currently adapted a local existence, where some move towards a more national influence, but lacking the pieces of Geels (2006) criteria for system innovations means that the solutions can do little to effectively influence the regime and instead only lure in consumers already primed for niche created by consumer awareness.

As seen in Table 6, there is a clear drive for creating new solutions, case systems offer some prospect for national development when there is a clear involvement of a big actor within the regime willing to take on the experimental state of the innovation. The larger and more influential, the actor-network the more the effect and supposedly overcoming consumer practices that would otherwise be indifferent.

Advantages clearly favor large operations, and shortcomings are often found in availability to the consumers. It is noticeable when Purely Professional offers its sustainable product without the ability to access a reuse station, reveals a lack in co-evolution of the system change along with a lack of actors willing to take on the product as a reuse product.

Therefore, changing the practices of consumers are unlikely if it is not available to them, within realistic bounds – so when LØS Market switched to use WOLT as a method of delivery during COVID-19 to prevent loss of consumers, there is an emphasis on the availability that needs to be offered to the consumer.

Though the system innovation is not necessarily primed for sustainable changes, in which new system changes can easily be harmful. Notably low return rates from reuse schemes, in the experiment phase, deals with the issues of consumers to impose value on the product in reusing or returning it. Whereas non-packaging schemes leaves out the need to impose value on the packaging to make sure consumers return it – but without legislation the consumer is free to buy plastic packaged goods regardless of availability, with a 55% indifferent demographic to pick and mix as they so choose.

The missing piece to this study is the Extended Producer Responsibility and how it will treat the efforts of companies to evade the bill imposed on plastic packaging, and if this indeed drives consumers towards non-packaging practices and local stores all-together.

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