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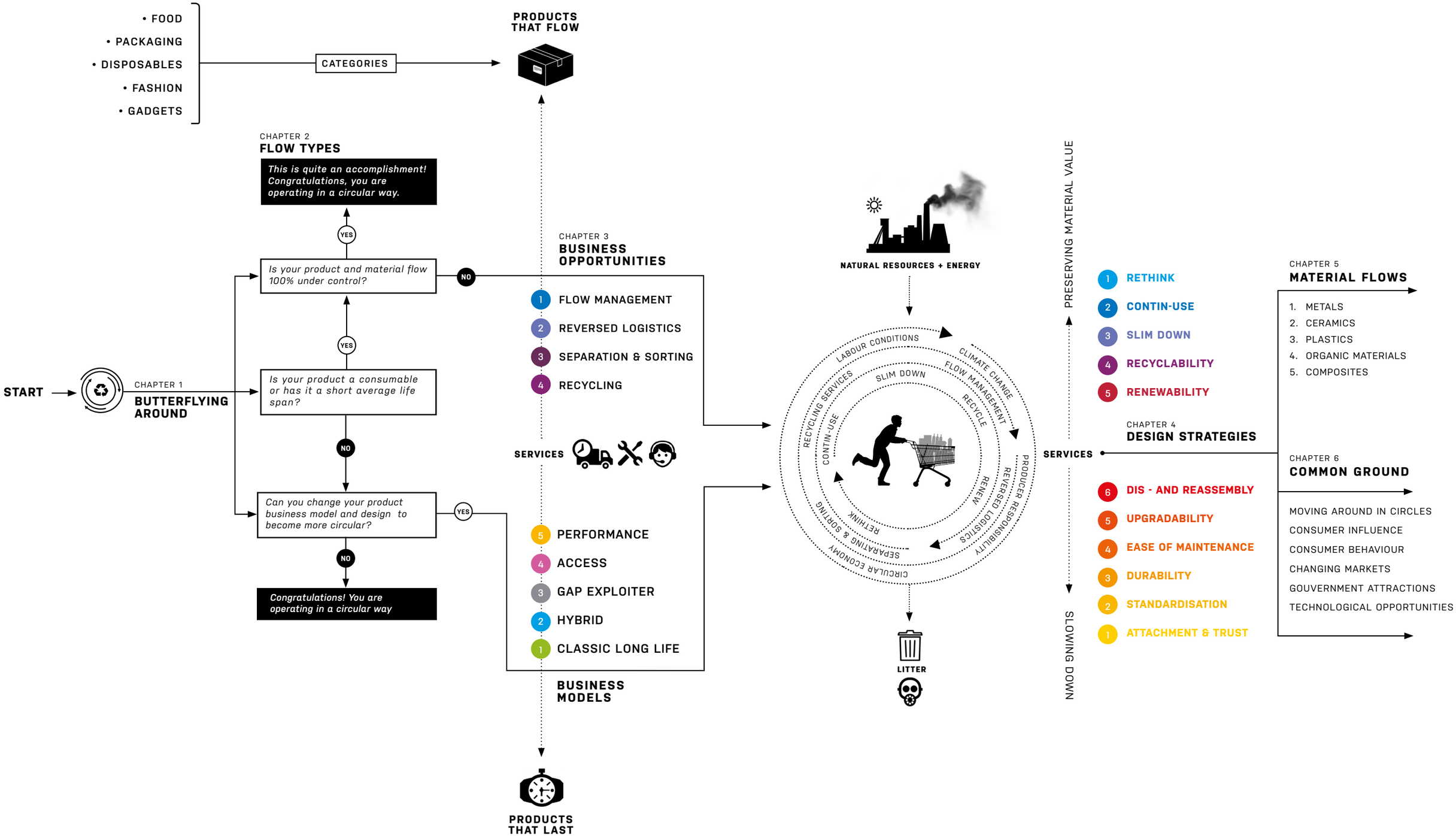
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YES
Is your product and material flow 100% under control?
NO
YES
Is your product a consumable or has it a short average life span?
NO
Can you change your product business model and design to become more circular?
YES
NO
Congratulations! You are operating in a circular way
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Smart packaging contains integrated technologies, such as NFC chips, Bluetooth, LEDs or screens for food and drugs, reducing potential waste throug better stock management.

Biodegradable disposable gloves for medical use and food industries. In 2017 the global rubber gloves market was valued at 2.35 billion U.S. dollars.

Systemic changes are required to change the way we pack and deliver our products. This will take time. However, there are also readymade activities that companies may be able to start implementing right now. They involve measures such as rethinking the system in the direction of sustained use of packaging, or a switch towards biodegradable materials.

Disposables' sales are on their way up too. There are two main areas of disposable trade. Medical disposables are used in surgery, drug and fluid administration, wound management, diagnostic testing, patient examination, incontinence management, dialysis treatment, sterilisation and blood donation etc. And finally, infectious waste disposal. The turnover in medical disposables is getting larger, due in part to an ageing population, improved health facilities, but mainly because handling, packaging and management of cleaning and sterilising used equipment, instruments and fabrics has become unaffordable. Processing rules for sterilisation are very strict.

The average amount of disposables used in the USA is 14.9 kilograms of waste per patient bed per day, which adds up to 2.6 million kilograms of waste each year.

There could be a solution in continued use for parts of the equipment, when, for instance, discarded instruments and sheets are cleaned, but not necessarily sterilizsed anymore, for normal unsterile use. Currently this happens informally.

Demand for foodservice disposables in the USA is growing too. It is a multibillion dollar trade expected to grow at a rate of several percent per year. Limited service restaurants, which account for 80 percent of the market, push most of the growth.

Retailers also continue to expand their range of prepared foods in order to better compete with restaurants and takeaway brands. In addition, restaurants add new beverages to the menu, such as coffees, smoothies and teas. These changes of course boost the introduction of new food disposables and packaging. The challenge to find harmless alternatives is formidable, and captivating because of this.

Fashion drastically changed in the 1990s. It used to be based on certain designers proclaiming looks and silhouettes for the coming year and the market purchasing accordingly, well sort of. Now it has developed into the most destructive trade after the fuel industry. Style change has almost come to a standstill, but items with 'different' details, prints, folds and seams, evolve from computer drawings to the shop shelf in a matter of weeks. Items are produced very cheaply under harsh circumstances in the Far East, but also in countries like Romania, Albania and the Ukraine.

The items are so cheap that customers often don't even bother to try them on in the fitting room. Clothes are only worn a few times, if at all: of 173 clothing items in the personal wardrobe in Denmark and the UK, about 50 have not been worn over the past year. At times items are disposed of to create wardrobe space for new identity illusions. The young

Biodegradable foodservice products are becoming increasingly popular with business owners who need to meet the wishes of their customers in looking for new ways to protect the environment. The best way to reduce waste is to not produce it in the first place. This is often called precycling or source reduction. Removing the trays so students do not take too much food has reduced campus dining facilities food waste by around 35%, saving millions of gallons of water and chemicals and cutting labour costs for dishwashing.

Fully automated robot driven Autostore Systems distribute all sorts of products at lightening speed while hughe scale outsourced manual labour in the Asian garment industries chases the 'just in time delivery' deadlines for our cheap fashion industries. After all these well organised highly skilled activities all end rather disappointingly in piles of waste on a landfill.

All materials and parts neatly brought in, prepared and arranged, everything in precisely the right order, on the right spot, just in time, quickly assembled with ingeniously designed details, perfect transportation, maximum control until delivery: that is what well-organised production should look like, including of course decent labour conditions.

BUSINESS OPPORTUNITIES FOR CIRCULAR FLOW

In the material sense, producing, selling and logistics that are currently running smoothly. The process from design to shop and direct delivery, has never been so well arranged on such a massive scale and it keeps speeding up. Typically, in fashion chains like H&M and Zara it takes just a few weeks. For food the principle of following seasons (time) and growing vegetables and fruits locally (place), is being supressed to the point that it is vanishing. Fresh produce every day is the benchmark, even if it has to be flown in from half way across the globe. Another category, cheap novelties for football matches and royal weddings, can appear out of the blue in just a matter of days.

The contrast with the part of flow that comes after the production and delivery deadline, the value drop to waste sequence, couldn't be more striking. Lack of responsibility particularly shows, when we consider the groups of low-value products that are mostly addressed in these chapters: food, packaging, disposables, fashion products and gadgets & giftware. With few exceptions, some of which are shown elsewhere in this book, attempts to arrive at a certain degree of limiting and controlling waste, have so far been insufficient. Some companies do their very best. There are taxes and rules. There are mandatory deposits. This helps, but there is money to be saved and made here. And, as opposed to sitting back and doing nothing, taking responsibility to contain waste provides liveability and bolsters reputations.

When we analyse what happens to value in flow products, it is logical to make a distinction between two possible directions in which improvements can be made.

Slow-down is to direct the attention towards cultivating and sustaining product value rather than allowing it to drop so terribly quickly. This simply entails slowing down flow and turning the partaking products into the kind that is more susceptible to control: good old products that last.

Organising loops is to concentrate on flows and try to organise them in such a way that the harm they inevitably do is brought to a minimum. Slimming down flows and optimising transportation and processing have the potential to save costs, whereas organising flow and segments of it can become a solid basis for new services.

At vegetable company Eosta / Nature & More they believe that organic products should not be packed, unless there is no other option. First and foremost they want to get rid of plastic. Their quest has taken them from PLA and other non-oil-based plastics to sugar cane material, compostable stickers, carton trays and, Natural Branding. Natural branding concerns creating an image directly on peels. A high definition laser removes pigment from the outer layer of the skin of the product. There is no detrimental effect on taste, aroma, shelf-life and edibility. Just with avocados, Eosta will save 750,000 plastic flow packs in 2017.

The company Soap by Mail had to overcome several barriers. They needed the help of a chemist to develop concentrated soap. For packing they used Polyvinyl alcohol, a dissolvable material. This proved to be extremely useful, since it actually improves the detergent. The box had to be designed to fit through a letterbox defined as 'large letter' by the UK's Royal Mail.

In some cases, the product can be changed to render packaging superfluous. Soda stream promotes itself with such a feature. They don't provide readymade soda mixes. Rather than shipping bottles around the world, they provide a machine with a carbonator bottle. Depending on its size, it makes from 30 up to 130 litres. Lush, a personal hygiene company, offers a broad range of products that come as solids, where liquids would be expected. For instance, they sell shampoo bars and hard deodorants, thereby altering the packaging concept. Some products do not require packaging.

Angus Grahame set up Splosh in 2012 with the idea that there must be an opportunity to sell household cleaning products online. However, the typical size and weight of the products was unpractical. Therefore, he embarked on a total makeover. Splosh customers now purchase a starter box containing a range of reusable bottles. In each of those, consumers can make their own cleaning products by mixing a sachet of concentrated liquid with warm tap water. Sachets in packages arrive through the mailbox. Several companies offer a similar alternative to liquid washing detergents.

For a lot of liquid consumables, a refilling system can be a solution. Concentrating the juice or the detergent can save a lot of packaging and logistics. For the customer this may require some extra handling. Good examples of this option are sauce dispensers in restaurants and soap dispensers in hotel bathrooms. They may save money but do require refilling and cleaning.

Many food products are already packed in their own skin. That is what contains the food and protects it, and in the case of bananas, provides peeling convenience. There happens to be a rule in the Netherlands that organic products have to be clearly distinguishable from the nonorganic ones. This is usually achieved by packing the organic ones in plastic, which is cheaper than the other way around, because there's simply fewer of them. This is awkward, particularly from the viewpoint of organic customers.

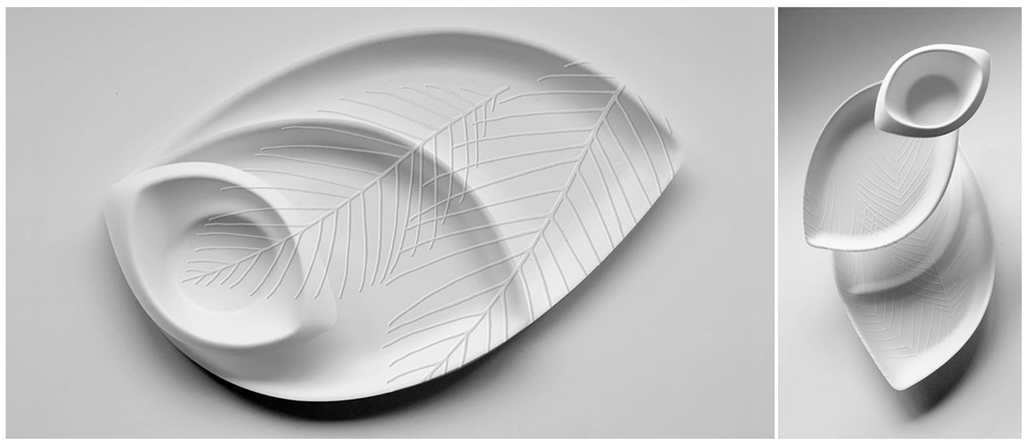
Peeze developed a biodegradable pod as an alternative to existing aluminium and plastic ones.

Bio-materials can be used in all flow products, but they are not equally normal. We have already established that the main drawback is maintaining flow purity. In packaging this can be complicated.

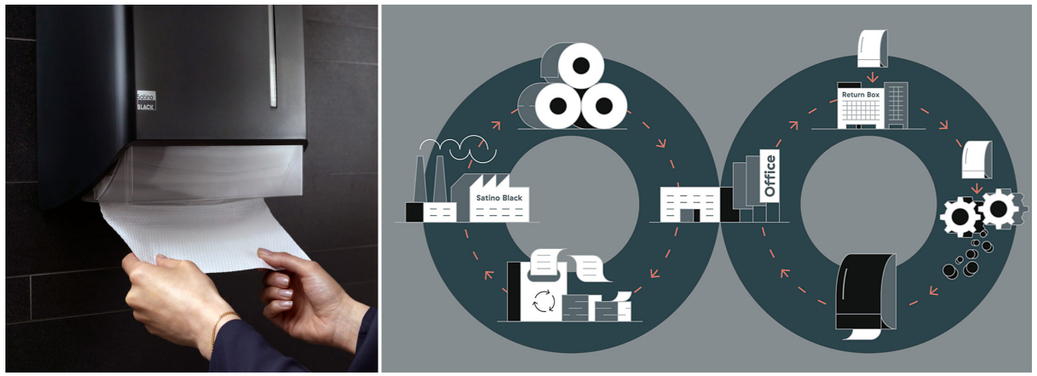
Together with ATI (Advanced Technology Innovations), coffee refinery Peeze developed a biodegradable pod as an alternative to existing aluminium and plastic ones. The new capsules and the sealing film both consist of PLA (polylactic acid), a compostable thermoplastic. It complies with the European standard for compostable packaging EN-13432 and is therefore allowed to wear the Seedling logo. A special grade of PLA needed to be developed to both withstand the temperature of hot water and allow correct perforation under high pressure. In addition, the material has to retain the coffee flavour.

For disposables the ease with which flow can be controlled depends on context. The loop of food containers as used in coffee and snack restaurants is not as closed as it can be in professional environments, such as hospitals.

For Rijnstate Hospital in Arnhem, food designer Katja Gruijters developed a new disposable tray and dinner service. She worked together with product designer Fons Broess and the product is being produced by



Compostable crockery designed for Rijnstate Hospital in Arnhem by food designer Katja Gruijters and product designer Fond Broess



Used office paper, coffee cups and drinking cartons? Dutch company WEPA turns them into Satino Black. You wouldn't think it with such a name, but it is toilet paper. It is a regional setup, so transportation is limited. Its production is certified to be100 percent safe and CO2-neutral. Satino Black hygienic paper has won the international WWF Paper Award.

disposables manufacturer Papstar. The intention to use it for all meals provided the designers with an opportunity to rethink the entire system.

The most notable characteristic is the complete disappearance of the tray, or its merger with the plate: the 'serving plate'. The set consists of three plates, the smallest of which is also the deepest and can contain soup or porridge.

It is designed to become part of an entirely new composting system with considerably simplified logistics. The plates consist of cane fibres, a plant-based material, which is represented in the looks.

After pressure from social media, computer producer DELL has decided to work towards sustainable product packaging. They have for instance reduced the size of their boxes by ten percent. Dell has also started to use wheat straw, which is agricultural waste on which mushrooms are grown: rice hulls or wheat chaff are placed in a mould and injected with mushroom spawn. Five to ten days later, the mushroom roots have created a connecting structure defined by the mould. After drying in a kiln, the straw composite shapes can serve as cushioning in boxes: cheaper and more energy efficient than plastic foam or cardboard.

GREEN PACKAGING: ***Dell has been an innovator in using materials from nature for packaging, having already incorporated bamboo and mushrooms. Now, the next evolution in sustainable materials is wheat straw.***

from a chemical reaction that starts by bringing together reacting fluids, or by putting the unset material under the influence of light, or pressure and heat. Thermosets are quite strong and stiff, and they can withstand different influences. Melting is not what they can do. Heat can distort their integrity and they may burn, but they won't get softer and turn liquid. This makes them comparable to crystalline ceramics when it comes to recycling. Shredded thermosets can be applied as a filler. There are chemical ways to divide them up into different compounds that can be reapplied. A large-scale return to the original thermoset resin, however, is as yet close to impossible.

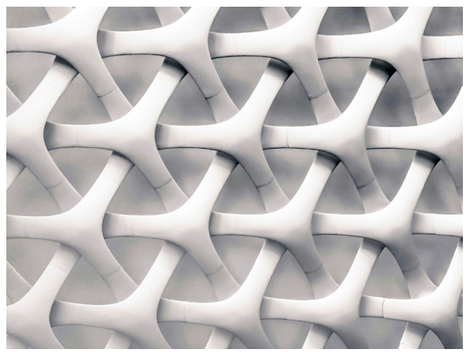
2. Rubbers are very soft and elastic, when compared to thermosets. They are produced by chemical treatment of latex from rubber trees and quality is enhanced by adding sulphur under high pressure: vulcanisation.

Since car tyres are made of rubber, the material is omnipresent. Car tyres have evolved into sophisticated compositions of steel wire, layers of fabric and rubber. There is a system to 'reemploy' the tyre materials after use, including even the minerals they picked up from roads. These tyre materials end up in different applications, such as roof tiles that can hold water for plants. Experiments are going on to 'de-vulcanise' rubber, which would imply that sooner or later rubber compounds could contain 50 percent recycled rubber. Incidentally, the word is derived from the verb 'to rub'. It was first used to wipe out mistakes made with a pencil. Synthetic rubbers exist as well. In fact, the 'rubbery phase' is a physical condition that all thermoplastics possess within a certain temperature range.

3. Thermoplastic's long carbon-based molecules are not fixed in complicated net structures, like thermosets and rubbers, but they are loosely arranged along and around each other so they can 'move' a bit. They have an amorphous character, some kinds more than others, which makes them behave somewhat like glass. They also get more transformable when they are moderately heated, certainly when compared to glass or steel. They don't have a precise melting temperature, like steel, but a melting and setting trajectory.

There are many ways to 'freeze' them in a certain shape. They all start as grains ('granulate') that are melted. Next the hot plastic is extruded to become profile, or pipe, or plate. Pipe can be inflated to become foil. Plate can be used to be heated again and formed in moulds with some air pressure: thermoforming. Many packaging trays are made in this way. The procedures to add all kinds of pictures and texts to the surface are manifold and quite sophisticated. The most precise shaping technology is injection moulding: high mechanical pressure injects melted plastic in a mould that defines the product. Some moulds are very advanced (and expensive). Packaging for prestigious perfume brands may consist of different colours of material that in the mould are transformed into very complicated structures, which for instance include a relief of text of one colour against a background of a different hue: all to prevent the packaging from being copied.

There are different kinds of thermoplastics, thousands if you just look at formulas and



recipes. Here we limit ourselves to three main subfamilies:

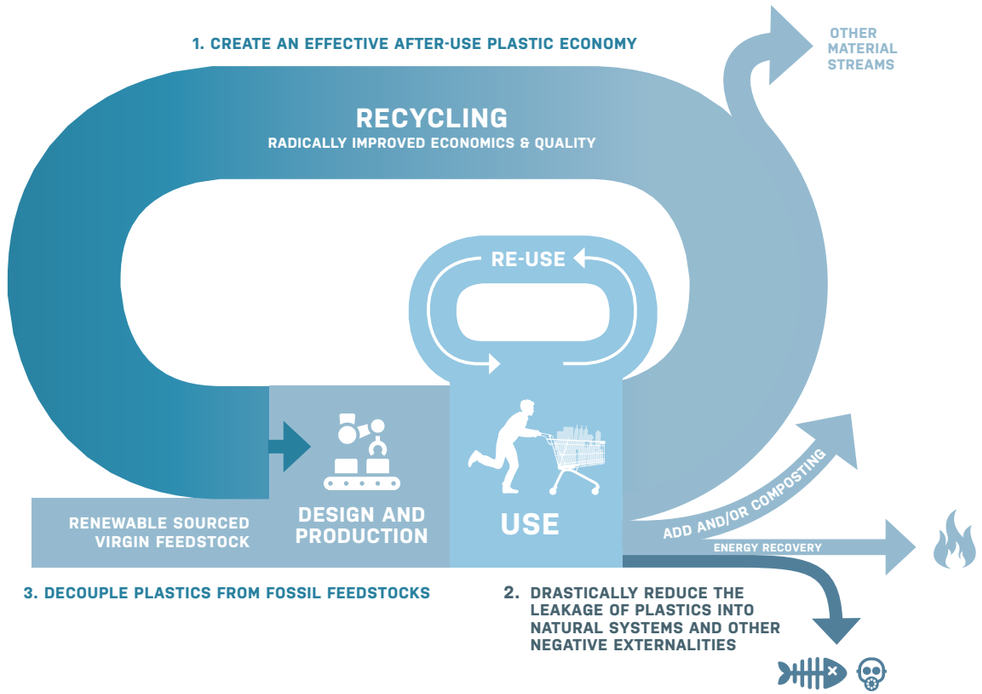
POLYOLEFINS is the collective name for two soft and versatile, tough polyethylenes and polypropylenes. They are used in gargantuan amounts, particularly for easy packaging. Think plastic bag and you understand that they are all over the place. The subdivision is not entirely strict. There is an extremely pure type of polyethylene, with well-arranged parallel molecules, that is known as Dyneema, one of the strongest fibres on earth.

Recycling is possible, as in all cases dependent on flow purity, which is hard to achieve. Collecting, or rather controlling them to a sufficient level, is difficult.

STRUCTURAL THERMOPLASTICS, the most important of which are PS, ABS, PVC, PC, PMMA and high-grade types, like PEI, PEEK and PPS, are robust and used for an enormous range of different functions, packaging and small products, like coat hangers and office accessories. However, they are also used to define the body of electric and electronic products, car parts and airplane parts. The mass-produced kinds contribute to waste as well and are difficult to distinguish from each other.

Gap exploiting designers often turn them into new products by adapting them to the aesthetic conventions of design products. They like to use PET bottles, but these happen to be quite well recyclable, due to the existing retrieval systems. There is no harm in plastic waste design, often meant as a statement in favour of recycling and continuse, but its contribution to plastic waste reduction is symbolic.

BIOPLASTICS differ from the other thermoplastics in that they are not made from crude oil. Their carbon base is derived from plant materials. Again, there are different kinds with different grades of degradability, which is their alternative to recycling. Some are made from carbohydrates and for instance used as trays for snacks. These can dissolve in water. PLA (Polylactid acid) is currently is the most important one. It is compostable, given the right industrial conditions. Bioplastics over the years have had a hard time proving their right to exist. When they appeared, the general feeling was that their ability to dissolve should be functional. In slaughterhouses for instances they use dissolvable plastic stoppers to keep all the moisture inside carcasses temporarily. In greenhouses they use them for clips to tie up tomato plants. Bioplastics used to be mistrusted because of their flow contamination risk. This is gradually changing. It could be that their ability to disappear is turning into a functional asset to reduce the amount of energy needed for recycling.



The flow of plastics in a circular system (Source: Ellen MacArthur Foundation)

herald new potential for change. Capitals other than just the material are being discussed and defined.

Engineers tend to consider the side effects of material and energetic 'overflow' – let us call it that – mainly a technical problem that can be solved by innovation of products, transportation and recycling procedures. With companies and designers, they focus on the concept of circularity, in which ideally all goes around in a perfect circle of material utilisation. Here the natural ecological circle, in which ideally all interventions together allegedly produce a zero-sum output, is the ideal metaphor of this way of attacking wastefulness. This very book is created along these circular lines, but not without awareness of the fact that the idea of circular economy as a benchmark is merely a stage in methodological development. Circular economy does not sufficiently address the inevitable imperfections of resource exploitation and waste production, nor the continuing increase in energy consumption. Nevertheless, the circle is a strong metaphor to bring people together to start working on a tremendous amount of ideas to adjust the systems we have developed.

MOVING AROUND IN CIRCLES

The largest unit of human organisation is government. It is not easy to cover all about governments in one sentence but let us have a go. Governments function on different levels of scale: local, regional, national and supra-national (European). Depending on place and time, they have different kinds of authority, which depends on a continuously shifting balance between population preferences, capital, individual power and charisma, job security, lobbyism, legislation, violence, paranoia, idealism and political skills and certainly more.

Governments behave opportunistically. They act on support through political outcomes, which are difficult to predict. Timing is crucial but coincidental. This implies that there may be a decision, for instance to prescribe mixing a certain percentage of biofuel with fossil fuel, which at first seemed beneficial to emission reduction, but after a few months proved otherwise. In addition, it would go at the cost of soil

for food production. Soon the measure had to be abolished. This all happened in Europe in 2007. Government decisions, however, depending on the political situation, usually demonstrate good intentions, for instance by forbidding plastic bags and drinking straws. They do tend to concern symptoms instead of causes. After all, the best way to start emitting less CO_2 is to diminish energy dependence, a challenge of innovation that governments tend to avoid, because it is thought that reduction hampers growth.

All the aforementioned plus everyone else, no matter what they do, participate in society. That is where public opinion, beliefs and behaviours emerge from events, alternative facts, news, experiences, facts and preferences. Society is chock-full of them and there is a general idea that somewhere over the rainbow lives an entity, which is The Solution. Supposedly, it is easy. All we have to do is take a spoonful of creativity and find it.

If only it was as simple as that. There are always reasons to hesitate about change for the better. One kind could be named 'current knowledge'. It looks like this: "If we would partly replace fossil plastic packaging with bioplastic packaging, the recycling flow world be contaminated. Therefore, bioplastics are a bad idea." This way of reasoning hampers long-term development, because it neglects the potential to find new answers now and try and optimise them for functioning later on.

Probably the most important inhibitory effect on diminishing the environmental effects of the flows we produce is the question who is responsible, which virtually always ends up in waiting for 'the others'.

At the most, an individual will feel somewhat guilty about drinking soda pop through a plastic straw, but the café manager is really held responsible. As a consumer, one feels powerless, because of the idea that, for instance, to continuse one second-hand blouse instead of buying something new, won't change anything.

Already there's a dilemma too. If you save money by purchasing a used item, you will have to decide on an alternative to spend it on. It could be a responsible fashion innovation, so you must wait until some company launches that, or until

In 1941 the British gouvernment lanched a campaign to encourage people to take good care of their clothes and mend them when they became worn, rather than throw them away and buy new ones.

government rations clothing. As a matter of fact, this happened in the 1940s in the UK, when scarcity ruled because of the war. Government took control over the British fashion industry by issuing *Utility Clothing*. This is a brilliant example of how shared interest can create support for vast adaptations to circumstances: in this case scarcity through war. It may well be that currently we should not be looking for The Solution, but for an urgency that is close and concrete. Searching is wiser than waiting.

Trade and industry, in their turn, tend to wait for markets to make responsible choices. They offer responsibility and greenness as a feature and react on numbers of people that use their products. For most customers, on the other hand, behave more on intuition than on awareness. Greenness to them is important as far as it is within what could be named 'the atmosphere of normality'. They buy green 'because everyone does'. This choice does not imply sensibility.

An interesting example is gluten. About one percent of people develops coeliac disease and about five percent is sensitive to gluten. Yet, the market for gluten-free cereals currently amounts to about 30 percent, because people identify with healthy food. Producers gladly comply. Apple's Steve Jobs said: 'It is not the consumer's job to know what they want'. This is the reason companies are the strongest implementers. Nevertheless, they come with proposals and wait for developments in 'the