



## **Case study report - Haval**

*Good practice of circular economy business models*

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**As part of the TRANSFORM-CE project, several case studies are done to benchmark existing circular economy business models. This document covers the results of the case study conducted at Haval, based in the Netherlands. A total of 20 case studies will be done, with five cases per country (The Netherlands, Germany, Belgium and the United Kingdom).**

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## 1. Introduction and method

### 1.1 Goal of case study

TRANSFORM-CE is an international research project which researches amongst others (successful applications of) circular business models, barriers, enablers and needs for circularity, and offers in-depth support for the uptake of recycled feedstock by businesses. A core part of the project is to provide advice to businesses on their way to transition towards a circular economy (CE).

In order to help businesses with developing circular business models (CBM's), it is first important to benchmark existing CBM's of companies. This is done by conducting case study projects with 20 selected businesses throughout North-West Europe. The aim is to provide participating businesses with an in-depth analysis of their current situation and business model, to identify opportunities and provide recommendations for facilitating the transition towards a CBM for these and other companies. The case studies also present an unique opportunity to study barriers, enablers and needs for circularity (and recycling) in more detail.

### 1.2 Company background

Haval is a family-owned business that produces food-related disposables and packaging (such as plastic cutlery, plates, yoghurt cups etc.). Currently, they are manufacturing products in high volumes at the lowest possible cost. Due to the recent introduction of the single-use plastic (SUP) directive, going into effect on the 3rd of July 2021, almost all of their products will be banned. Hence, Haval is currently undergoing a transition from single-use products to reusable alternatives (under the name Circulware). This entails many changes in the business model, from directly delivering to consumers to the implementation of reverse logistics and extending their product range. A short overview of Haval is given in table 1.

**Table 1:** Overview of company

Topic	Information
Company name	Haval
Website	<a href="http://www.haval.nl">www.haval.nl</a>
Country	The Netherlands
Size of company (0-10, 10-200, 200-500, 500+ employees)	10-200
Mission/vision	Mission Circulpack: "Reducing CO <sub>2</sub> -emissions by stopping the waste of single-use packaging through the use of reusable packaging." "Circulware = your circular tableware!"
Product category	Disposables and packaging
Production/operational process	Injection moulding
Used materials	PP and PP blend with biobased filler

### 1.3 Case study process

The case studies are being carried out between September 2020 and December 2021. The case study process is structured in four steps<sup>1</sup>, with an iterative approach at the end of each step. The first step (circularity of the business model) aims at creating a general overview of the company, the context and its (circular) business model, to capture how the company creates and delivers value. The second step (circularity in the value chain) involves a circularity assessment of the company and its activities in the value chain. The third step (circularity of operational activities) is focussed on the circularity of the company's operational activities. The last step involves a wrap-up of the results and concludes with the case company's strengths in regards to circularity, an overview of the barriers and enablers for circularity, and opportunities for further enabling circularity. The final result is a case study description, covering the previously established information.

An overview of the case study analysis process is shown in figure 1 on the next page. In order to obtain the results, each of the three steps is divided into four sub steps: 1) desk research and preparation; 2) interview; 3) reporting results; 4) iteration of results. More information about the process and the steps needed for receiving the results can be found in a separate document ('case study methodology') explaining the case study process in more detail. Three interviews are conducted for this case study, with one interview per step and the interviewed persons each having a different function and responsibility within the company. Table 2 gives an overview of the interviewed persons for Haval.

**Table 2:** Overview of interviewed people

	<b>Interviewed person</b>	<b>Function</b>
Interview 1: Circularity of business model	Erwin van Limpt	CEO
Interview 2: Circularity in the value chain	Roel van Dijk	Supply chain manager
Interview 3: Circularity of operational activities	Ron Kastermans	Production manager

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<sup>1</sup> We make grateful use of insights and methods derived from previous research, in particular the case study method of R2π (2017, 2019), the work of Circulab (2020) and the Ellen MacArthur Foundation (2017, 2019).



## 2. Circularity of business model

The first step aims at creating an overview of the company's business model and the context in which it operates, to capture how the company creates and delivers value (for circularity).

### 2.1 Circular business model canvas

The circularity of the business model is investigated by using a circular business model canvas (CBMC). This model is created for the purpose of this study and shows how the company creates, delivers and captures value, highlighting circularity aspects of the business. The CBMC of Haval is visible in figure 2 and a description of each element is given below.



**Figure 2:** CBMC of Haval

## **Value proposition**

Haval produces food-related disposables and packaging. Where they previously focused on producing as many products as possible at the lowest possible cost price, attention is now focused on setting up a new business model that focuses more on offering products as a service. This includes positioning of products where customers pay per usage of the product, rather than focussing on individual product sales. Instead of solely producing products, Haval intends to offer a complete service, including delivery and collection of products, and washing and sanitising between each of the product's uses.

*"Due to the disruption of the SUP-directive that will take effect in July 2021, we are now in a transition from single-use to reuse."*

- Erwin van Limpt, CEO van Haval

The SUP directive (i.e. ban on plastic cutlery, plates etc.) has pushed companies and customers to look for other alternatives to single-use plastic products. Next to offering products as a service and focussing on reusability of products, Haval is also researching new materials options and recyclability of products. Because of the need for completely new products and materials, there is less discussion about prices of products. This comes along with significant changes in the positioning of Haval's products, the products they offer and the markets they sell to.

Previously, products were developed and produced with as little material as possible (to reduce costs). If more material is used for products (partly to make it reusable), they will also be positioned in a different way, as products are of higher quality (nicer to cut with a knife from more material). Hence, focus is no longer placed on reducing materials for cost efficiency, it is rather placed on improving product designs to increase durability and allow for reusability, while using as little raw materials as possible per use of the product.

## **Customers & users**

Currently, Haval supplies its products to wholesalers in the food industry (e.g. Makro, Sligro, Hanos). Products are eventually supplied to caterers, restaurants, coffee operators, amusement parks, company canteens, festivals and retail. Some customers also buy products directly from Haval (e.g. Douwe Egberts).

The repositioning of the company to provide products as a service, rather than individual product sales, also causes changes in the customers they target. Where Haval was previously supplying products to wholesalers, who then sell the products to their customers, they are now considering to directly supply products to these customers (e.g. caterers, restaurants etc.). However, they also do not want to cut out wholesalers, so if possible they prefer to act together with them. Moreover, Haval is reluctant to produce products for businesses who will further market them, because they will lose sight of the product and its life cycle (what happens at end-of-use) and they may lose their revenue model.

Haval's current products consist of disposables such as cutlery, stirrers and plates, and packaging, including yoghurt buckets, snack tomato buckets and meat trays, see figure 3. With the new business model this range will be further extended with bottle caps (that need to stay attached to



the bottle with the new SUP directive). Moreover, a special product line called ‘Circulware’ is created, consisting of reusable food trays for events and the festival market (see figure 4). Covid-19 has also caused an increased production of take-away disposable containers.



**Figure 3:** Examples of Haval's current products (plastic cutlery, stirrers, cups, snack tomato buckets and plates). Source: [www.haval.nl](http://www.haval.nl)



**Figure 4:** Circulware range of Haval (reusable food trays, food containers and cutlery). Source: Haval

The current market of Haval includes export outside of the Netherlands, especially in Western Europe. These were important sales areas, but it is still uncertain whether the new products and business model will appeal to customers and consumers in all countries.

### Key activities

Haval's main activity is the injection moulding of food-related disposables and packaging. Products are currently produced in large volumes at the lowest possible cost, competing with companies in Asia and Eastern Europe. This means that the use of materials is reduced where possible, taking into account an effective design to increase strength with little material. Not all products sold by Haval are produced in-house, a small percentage is sold directly (e.g. plastic cups). This will become less and less in the future, they rather produce products themselves. Haval also offers the option to produce products with in-mould labelling.

Next to manufacturing activities, Haval also develops their own products and products specifically designed for customers. Customers usually come with a question and products are developed in consultation or collaboration with customers, ready for use when it leaves the factory.

Yet, almost all of the products Haval is currently producing will be banned from July 2021. Hence, with the new business model, business development is a big part of the company's activities. They

look for other products, other markets, other product-market combinations, etc. Moreover, focussed is placed on repositioning of the company and developing new products inspired by the SUP directive. This for example includes expansion of their product range with new bottle caps (due to requirements to connect caps to bottles) and the development of a product line for festivals and events, consisting of chips trays and food trays in different sizes (see figure 4). This line is ready for production but is postponed due to Covid-19.

*“We used to push to produce as many products as possible at the lowest possible cost price, but with the new business model we will focus on service as much as possible.”*

- *Roel van Dijk, Supply Chain Manager at Haval*

In contrast to Haval's previous offering of linear products, activities considering new product development include one or more of the following four points:

- Offering products as part of a service
- Reusability and circularity of products
- Recyclability of products
- Research into new materials

The company's new focus on offering products as a service may also include washing, sanitising and redistribution of products. Haval is planning to do this with people from the social workplace, who transport products with electric bicycles, to stimulate social sustainability. However, the service offering is still in the development phase and the final approach has yet to be determined. Furthermore, a number of pilot projects have started with different caterers to test reusability of products in practice (e.g. with the reuse of chip trays). However, the company also expects that reuse will not happen for some products (e.g. with coffee stirrers). Typical on-the-go products will always remain that way, but will then have to be made from other materials instead of plastic. For each product the question has to be asked if it will be suitable for reuse or if alternative materials have to be sought. Haval is actively looking for solutions in this field.

*“There will be products such as a stirrer or ice cream spoon of which we are convinced that reuse will not happen in practice.”*

- *Erwin van Limpt, CEO of Haval*

Additionally, Haval is also engaged in various tests and pilot projects concerning the recyclability of packaging, participating in pilot projects using watermarks for better sorting. This also involves designing products for recyclability (e.g. less colour usage, making products transparent). Tests are done to research how many times products can be recycled without down cycling products (e.g. can a plate be turned into a plate again and a cup into a cup).

### **Key resources**

The manufacturing of products takes place in the factory in Gemert (the Netherlands), with one of the 30 injection moulding machines. These machines are highly automated, with only few people

needed for controlling and supervision. They allow for fast production of products, in large volumes.

Haval produces both packaging items and disposables. Their packaging items are all made of polypropylene (PP) and for disposables polystyrene (PS) is being replaced with PP (because PS has no separate recycling stream in the Netherlands). Products are preferably transparent (to allow for better recycle by limiting 'greyish' colour), but options for colour and in-mould labelling are also offered to customers. For their multiple-use products, a special PP blend of Haval will be used, in which additives are used to make products firmer. The blend consists of a biobased filler, which provides strength for the product. Materials such as polylactic acid (PLA) and polyethylene terephthalate (PET) cannot be used because they are not heat resistant.

Moreover, post-consumer resin (PCR) cannot be used because recycled PP is not allowed for food contact. Post-industrial resin (PIR) from their own factory is being collected and tests are started to apply this in Haval's production process. PIR waste is not purchased from other companies because most companies use it themselves. Options for chemical recycled materials are considered and looked into, but not applied due to limited availability (since all bigger companies purchase these materials). Together with other manufacturers options are considered to act together.

*"We prefer a product made of 100% plastic that is meant to be reused and recycled."*

*- Roel van Dijk, Supply Chain Manager at Haval*

Haval prefers to use plastics (in a sustainable way) over other material options such as paper, wood, bamboo, etc. The ban on many plastic products has led to a switch from single-use products to reusable alternatives. Reusable products largely differ from current single-use products in their weight. Products are made from more material and are therefore firmer (e.g. cutlery is changed from 2 grams to 7-8 grams). This allows for products to be washed and reused again.

Next to machines and materials, Haval has approximately 65 employees who have been working there for years. A select team of employees is engaged in the development of new circular products and systems for their new business model.

### **Key partners**

The key partners for Haval are its raw material suppliers. Other important partners are energy suppliers and packaging material suppliers. Of course, more reusable products will change the relationship with those suppliers in the future. Additionally, Haval cooperates with various other companies such as other manufacturers, recyclers (e.g. Veolia), test centres (e.g. NTCP), consultants and social workplaces to discuss options to make products more sustainable. The new business model also entails other partners such as logistics partners, partners for cleaning, etc.

### **Distribution**

Distribution of products is outsourced to external parties, although some customers collect products themselves. Products go to wholesalers' warehouses and are delivered in full trucks. With the new business model, products may be delivered directly to the location, which also reduces delivery volumes. The introduction of a reuse model also involves reversed logistics of products

for cleaning and when they reach end-of-life. This concept will be further developed in the coming months.

### **End-of-use**

Disposables and packaging items of Haval currently end up in the trash. Products can be thrown away at consumer's homes or at the place of use (e.g. in restaurants, amusement parks or company canteens). In theory, products can be recycled, but in practice this does not always happen. Haval's products often end up in the residual flow and are incinerated due to the small size of the products (products <5cm fall through holes and are sorted out with contamination). Some larger products, such as plates, yogurt buckets and snack tomato buckets, may end up in the correct flow.

*"The wish is to remain the owner of products."*

- Erwin van Limpt, CEO of Haval

In the (near) future, Haval will offer access to products and will remain the owner. Products are designed and tested to be reused and washed 125 times. The idea is that, when products break or reach end-of-life, Haval will collect products and recycle them into new products.

### **Costs & revenues**

The company's current turnover is about 20 million euros a year. With the old business model they are paid by selling products, but with the new business model revenues will also come from: distribution, delivery, cleaning and return logistics. Hence, the company will be payed per use of the product rather than payed per transaction sale. They will need to manufacture and sell smaller quantities of products, at higher cost prices (more material in product and more packaging due to smaller delivery sizes) but with higher margins per product. Moreover, project grants make it possible for Haval to set up multiple (pilot) projects at the same time and further test circularity possibilities.

### **Policies & regulations**

The introduction of the single-use plastic (SUP) directive by the European Commission<sup>2</sup> (which goes into effect on the 3rd of July 2021), substantially influences the business of Haval. This directive incorporates measures for the ten most found items on European beaches, including a ban on plastic products where sustainable alternatives are available, such as cutlery, plates, straws, stirrers, and cups and containers made of expanded polystyrene (EPS). This also includes products made of paper with a plastic liner, and products made of biobased plastics such as PLA en PHA. The directive provided an incentive for Haval to actively look into options for reusability of products and the introduction of a new business model focussed on offering product as a service.

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<sup>2</sup> European Commission, 2019. *Single-use Plastics*. [https://ec.europa.eu/environment/index\\_en](https://ec.europa.eu/environment/index_en)

Striking is that plastic plates will be banned with the new directive, but plastic trays (where food is also served on, just like with plates), are still allowed. Haval is expecting this to change in the (near) future and has therefore already designed a new product line for reusable food trays.

*"It is strange that a plate made of plastic where you can put chips on is forbidden, but a tray where you can put chips in is not."*

- Erwin van Limpt, CEO of Haval

Plastic cups are still allowed to be manufactured and sold, but with specific marking requirements. Cups need to have the text 'containing plastic' or 'plastic in product' clearly visible on the cup, as a measure to reduce the consumption of beverage cups. The SUP directive also includes requirements to connect plastic caps to bottles (for all beverage containers <3L). Hence, Haval took this opportunity to extend its product range, by injection moulding caps that comply with the design requirement.

The SUP directive is introduced on European level, but each country may decide on its own laws to ensure compliance of the directive. This leads to a difference in implementation by different countries. For example, France will also ban all plastic cups and Germany will focus on reusable alternatives in fast food restaurants. The Netherlands is lagging behind in this and, although the laws will take effect in July 2021, concrete measures are still missing. Because of this, investments by Haval in, for example, new moulds is postponed until measurements are clear.

Next to the SUP directive, regulations prohibit the use of recycled PP for food contact. Recycled PET may be used if it can be shown that min. 95% is previously used for food contact (e.g. PET bottles collected through the bottle-return system). However, this cannot be guaranteed for other polymers such as polyethylene (PE) and PP.

## **Trends**

The introduction of the SUP directive and increased attention for plastic litter has caused changes in customer wishes. Hence, customers are looking for other options, including buying products from other companies offering products made from new materials (e.g. wood, paper, bamboo). This also includes the use of biodegradable materials, although these materials do not meet industry standards for biodegradation and are not regarded to be a suitable alternative. There are also customers who wait until products are no longer available (and banned) and will then look for the next cheapest alternative available. Furthermore, although food packaging is not yet prohibited (EPR applies for packaging), customers are already asking for weight reduction, recyclability, etc. In contrast to changing customer wishes, consumers do not have a choice. Supermarket chains (e.g. AH or Jumbo), restaurants and festivals already make choices for consumers by their product offer.

Haval also sees a trend in 'greenwashing' where companies tend to show that they are 'doing the right thing' but are still manufacturing thousands of new products every day. Another market trend that can be seen is that the use of PS is facing out, because it only has few applications. This makes the material less interesting for recyclers and sorters, causing the material to end up as a residual flow which will be incinerated.

Competitors of Haval are also extensively exploring other options. It can be seen that everyone is making choices: focus on renewable, recyclable or reusable. Options for other materials are also widely considered in the market, but may often still need a plastic liner. Such choices are considered to be very important because customers will also make choices. If these do not meet their wishes, clients will be lost.

*"Many other companies are switching to alternative materials, such as wood, cardboard, paper, bamboo, but then you keep throwing products away."*

- Erwin van Limpt, CEO, Haval

An economic trend is also clearly seen, in which virgin material prices are rapidly increasing. In February this year, a force majeure was announced (by all large suppliers, at the same time, due to shortage of polymers), terminating all contracts with agreed material prices. As a result, the availability of virgin plastics has decreased and prices of freely available materials have increased by a factor of two to three. This means raw material costs have increased with 50%, leading to 35% higher product prices.

Moreover, Covid-19 has caused a boost in sales for take-away and meal delivery. Therefore, Haval is developing new product lines for this. They have already developed a new product line with products specifically for festivals and events such as reusable food trays and chips trays. However, production is postponed because of cancellation of festivals and events due to Covid-19.

*"In theory, products are already recyclable, but you also want them to return to the flow."*

- Erwin van Limpt, CEO of Haval

On a technologic level, many new technologies are coming up. Haval is engaged in various tests and pilot projects concerning the recyclability of packaging. They participate in pilot projects using watermarks for better sorting. Watermarks may allow materials to come back in the (correct) flow in the near future. This works with embossed dots in the form of half circles, which forms a special code for machines. The code allows machines to determine, for example, whether products have been previously used for food purposes (to allow for more food grade recycled materials).

Furthermore, Haval participates in other initiatives such as the NL Plastic Pact<sup>3</sup>. In this pact, the Dutch government and companies are striving for (100%) recyclability of plastic products and packaging, high-quality recycling of products (min. 70% of all products), (20%) less material usage and striving for an increased usage of recycle in products and packaging (min. 35%).

### **Positive and negative impacts**

The main negative impacts for Haval are its high energy usage and CO<sub>2</sub>-emissions during manufacturing. However, it is also noted that CO<sub>2</sub>-emissions are often lower when compared to

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<sup>3</sup> Plastic Pact Nederland. (2020). *Over ons*. Meer Met Minder Plastic.  
<https://www.meermetminderplastic.nl/over-ons>

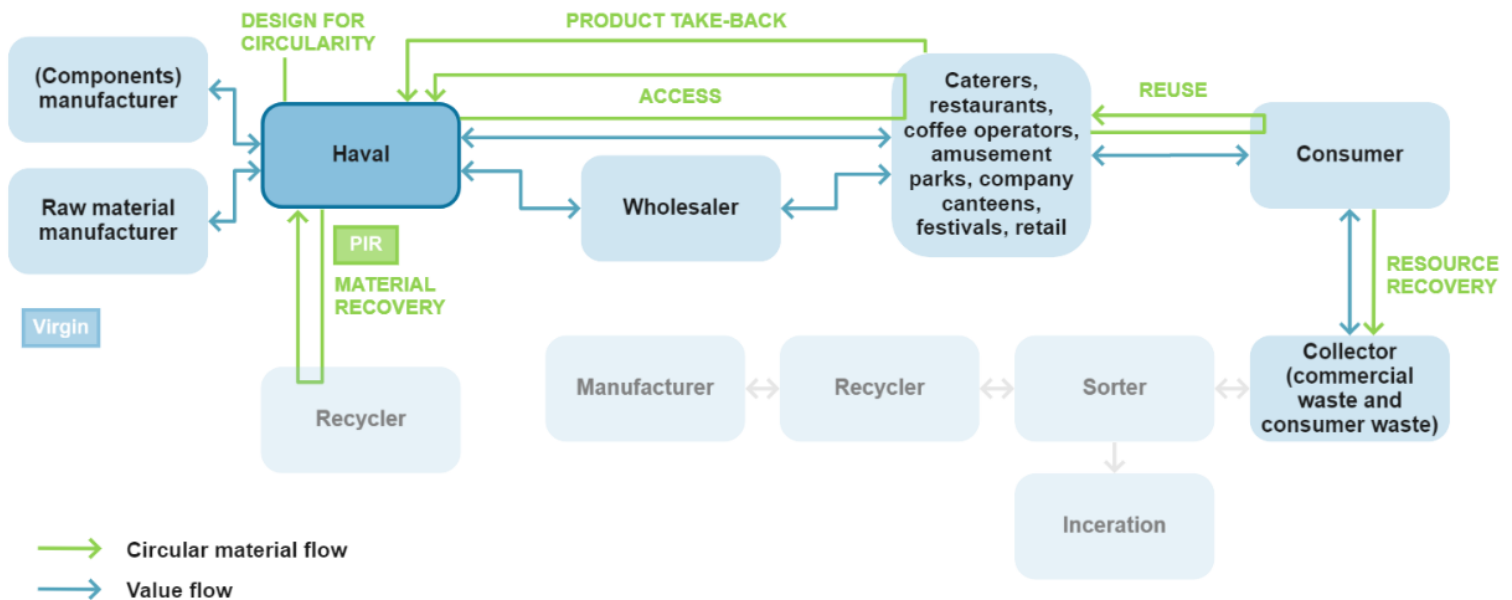
other materials, and will be reduced when products are used multiple times. To reduce the negative impacts of energy usage, the company is aiming to use fully electric machines with new investments. Such machines also use much less power and are considerably more energy efficient. Two other negative impacts are the use of resources and creation of waste from single-use plastics. Both will be reduced to a great extent when transforming the business model to reusable alternatives. Moreover, the use of fossil fuels is cut back by the use of (biobased) fillers in Haval's own PP blend. Other positive impacts include the involvement of social workplaces and the deployment of people with a distance to the labour market.

### 3. Circularity in the value chain

After analysing the company's current (circular) business model, a more detailed circularity assessment of the company and its activities in the value chain is made. The material and value flow map is presented, together with its adopted circular strategies.

#### 3.1 Material and value flow map

The ultimate goal of a CE is for resources to flow in circles, with limited leakage out of the system. To evaluate this, it is important to map and visualise the current flow of materials and value within the company's value chain. The material and value flow map of Haval is presented in figure 5. The value flows (blue) indicate that value is being exchanged between actors, and enables an analysis of the relationships amongst key partners. The circular material flows (green) show where the material comes from, where it goes and how it may return into the cycle.



**Figure 5:** Material/value flow map of Haval (with PIR: post-industrial resin)

#### 3.2 Circular strategies

As shown in figure 5, Haval applies multiple circular strategies: *material recovery* of production waste, *resource recovery* at end-of-life, *access* by offering products as a service, *reuse* of products by consumers, *product take-back* at end-of-life and *design for circularity*. Each of the strategies is further explained below.

##### Material recovery

'Waste' from the production process (PIR) is currently collected tests are being done for reusing this material in the production of new products. An external party is hired for reprocessing of the materials, due to lack of space for shredders in Haval's factory. The recycler shreds the material



and re-melts the flakes into granulates. Haval will then receive the PIR material in the form of granulate, which they can use again in production processes.

### **Resource recovery**

Currently, Haval's products are collected at end-of-life and end up as waste. Products can be disposed of by consumers at their homes, or at the place of use (e.g. in restaurants, amusement parks or company canteens). After that, waste is collected and goes to a sorting centre. Theoretically, all of Haval's products and materials can be recycled. However, in practice, many problems occur with the sortation of products. It is therefore important to *design products for recyclability*.

Materials of some (larger) products from Haval can be properly sorted and are re-melted into granulates, ready to be used by other manufacturers in (low-grade) products. Unfortunately, these materials are not suitable for food-contact, because it cannot be demonstrated that products have previously been used for food purposes. Haval is researching the use of watermarks to improve sorting (efficiency) and to distinguish between food and non-food materials.

Moreover, the biobased fillers in Haval's own PP blend may affect recycling, but only to a lesser extent. The blend can be recycled with normal PP, but the output of the recycling process will not be a homogeneous flow of PP.

### **Access**

In the new business model, products will be offered as a service, whereby access is granted to products and payments are made per use of the product ('pay-per-use'), rather than individual product sales. Offering products as a service may or may not include the washing and sanitising of products. It is likely that customers will be provided with an option: to do the cleaning of products themselves or to let Haval take care of the washing, sanitising and redistribution. Haval then offers this as part of their service, but will likely outsource cleaning of products, for example by the use of a social workplace.

The *access* strategy is currently being further developed, tested and implemented by Haval. The question is whether products will still be sold through a wholesaler, or whether they will be sold directly to their customers (e.g. restaurant, caterer etc.). At the moment, wholesalers are really necessary because of the large volumes of products. But if sale quantities are extensively reduced (because of reuse of products) and if products are offered as a service, it could be easier to deliver products directly to the location.

### **Reuse**

Where the *access* strategy is applied between Haval and its customers, *reuse* is offered between customers (e.g. restaurant or festival) and the end-consumer (see figure 5). A key challenge for this strategy is the collection of products after usage for washing and sanitising. Collection may either go through restaurant chains (at warehouses) or products are collected at each individual location where products are used. Setting up such a collection scheme is still under development. It could also be arranged through existing food delivery systems (e.g. Thuisbezorgd etc.).

By offering reusable products, incentives are needed for product take-back. However, Haval is confident that the service must come with no additional costs for consumers, in order for the

products and business model to be successful. Hence, Haval is looking into ways for introducing a certain fee if products are not returned (e.g. by registration in an app), in contrast to the use of deposits. They expect this incentive to be sufficient enough, but this will be further tested in the pilot projects.

Products are designed and tested to be reused and washed 125 times. This amount is based on the European standard indicating that products are dishwasher safe with 125 cycles. However, there are no fixed rules or regulations defining when products can be classified as reusable yet.

### **Product take-back**

With the new reuse model, Haval will always stay the owner of products. This also makes the company responsible for what happens with products at end-of-life. For example, damaged or broken products may be taken back by Haval, who then ensures that products are recycled and that materials are reused in the production of new products. This concept is being further developed by Haval. An advantage of product take-back is that it provides more control over product cycles, allowing products to be separately collected at end-of-life. This ensures an opportunity to reuse materials for food applications after recycling. Furthermore, the loop must also be restocked because of a smaller return rates (e.g. consumer keeps product for personal use).

### **Design for circularity**

Design for circularity by Haval manifests itself in three ways: *design for recycling, design for durability and performance* and *less material usage*.

#### *Design for recycling*

From a technical point of view, Haval's products are easy to recycle, but in practice there are losses during sorting or material quality goes down during reprocessing. Losses during sorting may happen because products are too small (<5cm). Moreover, the use of colour in products results in a 'greyish' colour output of recyclate, subsequently limiting the application possibilities for the material. For this reason, Haval is looking to apply transparent materials more widely. Furthermore, quality may also decrease because materials cannot be reused for food purposes. Haval is actively researching opportunities for this, for example by testing the use of watermarks to distinguish between food and non-food materials. The use of codes on products can help with demonstrating that materials have previously been used for food products and that they can thus be reused again for that purpose.

*"We are working on coding our products so that you know the origin of a food-safe material."*

*- Roel van Dijk, Supply Chain Manager at Haval*

Designing products for recyclability also includes taking into account the use of corresponding wall thicknesses for different products. This helps to create granulate of the same size, ensuring easier recycling (more homogenous flow and less temperature fluctuations during production).

#### *Design for durability and performance*

With the new business model, products are designed to be reused several times. Where products were first designed for single use at the lowest possible cost (less material), the focus in the future will be on strengthening products. This is mainly achieved by using additional material (from 2g to 6-8g for cutlery) and product design (extra edges on sides, rounder shapes), but can also be increased by using fillers. Products are designed based on a minimum use of 125 cycles, but with proper use they may be reused about 200-300 times.

*"Product design plays a very high factor in making the product more robust."*

- *Roel van Dijk, Supply Chain Manager at Haval*

#### *Less material usage*

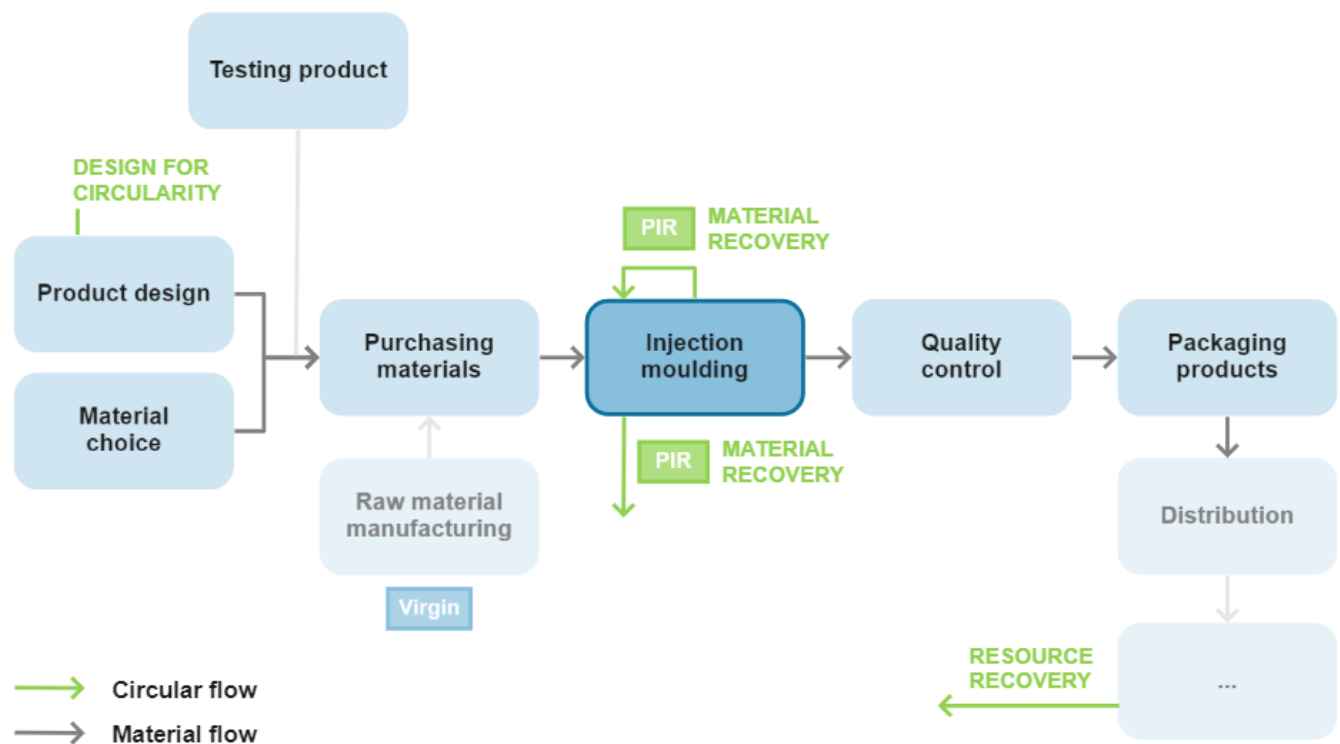
Although the material usage per product will increase because of the need for reusability (more strength), less material is used per usage cycle. Moreover, product designs are still optimised so that as little material as possible is used and unnecessary material usage is avoided wherever possible.

## 4. Circularity of operational activities

After assessing the circularity of the company's activities within its value chain, a more detailed assessment of the circularity of the company's operational activities is done. A visualisation of the operational process is presented, together with its adopted circular strategies.

### 4.1 Operational process map

To get a better understanding of how the company's operational activities are affected, an overview of the process is made, see figure 4. This includes circular sourcing of materials, the production process and quality assurance of products. Each of the steps will be further explained below.



**Figure 6:** Operational process map of Haval (with PIR: post-industrial resin)

With the focus of the new business model it is likely that additional steps will be added to the current operational process. This may include for example collection, washing and sanitising, and redistribution of products. However, this new business model is still under development, and will therefore not be discussed further at this moment.

### 4.2 Circular sourcing and design

The preliminary process consists of designing the product, choosing materials, purchasing materials and optionally also testing the product.

## **Product design**

Haval offers the option to design new products in collaboration with the customer, based on their request. Their knowledge about product designs, thin-walled products with enough strength, moulds and injection moulding all come in handy for this step.

## **Material choice**

In consultation with the customer, a raw material is chosen that is most suitable for the desired product. Haval mainly uses PP for its products, with approximately six to seven different types of PP, each suitable for a specific product. The thin-walled products of Haval require the use of materials with a high melt flow and high stiffness of the material. Moreover, some of Haval's products require additional material characteristics. This may be, for instance, the possibility for a storage container to be kept in a freezer, avoiding splintering of a salad tray with automatic lid placement, high transparency for tomato buckets etc. Such properties are established in the purchased materials. These requirements come from customer demands, but usually do not go hand in hand when multiple requirements are set. Hence, proper insights into materials is required to determine the most suitable material, which is where Haval's expertise is useful.

For Haval's disposables that are intended for multiple use, a PP blend is used to strengthen the product. This special blend of Haval consists of PP and a biobased based filler. A downside of this additive is that the material can (currently) not be properly recycled in industry (as mono-materials are desired). Therefore the additive is only used for multiple-use products (called Circulware). Theoretically, the material could be recycled if a separate stream can be created, by either separately collecting the material or using of code that can be detected by industrial sorting machines. The question remains whether this is feasible in practice.

For packaging, mono-materials are used, but sometimes it cannot be prevented to use additives. An example of an additive is anti-fog, used to limit condensation on the inside of a package, to improve visibility of the food content inside.

*"If we handle plastic well, it can be recycled correctly, making it an ideal material."*

*- Ron Kastermans, production manager at Haval*

Haval is not exactly equipped for the use of (post-consumer) recycled plastic. Key in this is the fact that Haval manufactures thin-walled products, which requires the quality of materials to be consistent. Other companies have large mixing silos (up to 20 tons) to create a more constant batch (because more material is mixed, the quality becomes more consistent). Purchasing such machines may lead to issues with insurance, which requires additional investments.

An option Haval is currently looking into is sending their production waste to a recycler, which they reprocess into granulate. Haval will then use this (post-industrial) recycle for the production of new products, mixed with about 50-60% virgin material. The recycler will also add colour to the granulate, so the material may directly be used in the production process.

## **Purchasing materials**

The introduction of the SUP directive, and thus a ban on many of Haval's products, has led to fewer materials being purchased this year. Moreover, the banned products were previously made from PS, which is now being replaced with PP for the multiple-use products.

Around November of each year, a prediction of the required amount of raw materials is made for the next year. Haval then meets with its two major suppliers to discuss prices for the polymers. Prices are set for the coming year, so there is no need to further negotiate in that year. Contradictory, the recently announced force majeure has resulted in suppliers not being able to deliver the required amount of materials. About 50-70% of the materials can be delivered and the remaining material has to be purchased on the spot market, with increased prices up to twice the original price. Moreover, the limited availability of materials also resulted in the need to purchase materials that deviate slightly from the standard (e.g. not stiff enough, or lower melt flow), simply because there they are left with no other option. This issue is expected to be resolved in July or August 2021.

## **Testing product**

Testing the product (design) is an optional process step, but is not always necessary. Testing may be done in various ways, of which the most common are using a test mould or making a 3D-printed prototype (which is outsourced). Test moulds are used for testing products on the production line, without the need a large mould that processes multiple products in once. As an example, a new product line is developed with caps that stay attached to the bottle. This is first tested with a smaller mould, allowing only one product to be injection moulded at a time. A few hundred products can then be produced and are send to the customer for approval. If successful, this may be scaled up and investments will be made for a larger mould to allow for the possibility of manufacturing 48 caps at once.

## **4.3 Production process**

The production process of Haval consists of injection moulding disposables and packaging.

### **Injection moulding**

All of Haval's products are produced with injection moulding. Packaging items are being made with PP, and for the disposables PS is currently being replaced with PP. This change of materials also requires other moulds. Where hot runners with a small hole are used for processing PS, the production of products with PP requires bigger holes in order for the mould to be properly filled. To make sure the runner is properly closed with the bigger holes, and to avoid running of material out of the mould, extra closures are needed to close of the hole. This way, the cooling time decreases and the overall process runs faster.

Once the production process has started, the quality of the product also remains constant. As a result, no more adjustments need to be made during production, as long as the same product is being made. When new materials or other additives are used for the first time, the process is additionally monitored for the first hour. The addition of colourants, fillers or other additives, for instance, influences the production process due to a reduced melt flow.

In the end it is the combination of material, mould and machine that determines the quality of the end product. These aspects are defined in advance with the design of the product. After a while the mould will wear off, causing the material to run slightly out of the mould. This is a sign that the mould needs to be replaced.

*“The combination of material, machine and mould determines the quality of the end product.”*  
- Ron Kastermans, production manager at Haval

During the production processes there are also losses of material. This comes from rejected products that do not meet quality requirements or from the first few products of a production run with a different colour (products with a mix of colours). The advantage of injection moulding is that, as soon as the line is running, there is limited production waste. The amount of production waste depends on whether a sprue or hot runner is used. When choosing a sprue, the sprue will be attached to the end product and is cut off after moulding. Haval only uses sprues for smaller products, such as coffee stirrers, with 80 stirrers attached to one sprue. In contrast to the use of sprues, hot runners direct molten material to individual parts, and the plastic stays liquid for a longer period of time. This leads to less production waste, and a more efficient process. Hence, Haval chooses to use hot runners where possible.

Haval has about 60-70 ton of production waste a year for PP. Part of this is waste from IML, which cannot be reused again for food products (due to inks). The other part is currently sold to other companies, but Haval recently started a test to see if they may re-apply this material in their own production processes. If it can be clearly demonstrated that the material comes from Haval's production process (materials are only used for food-contact products), then this material may be reused for producing new products for food purposes. In order to be able to apply PIR in the manufacturing process, it is important to make sure the material is not too polluted (with dust etc.), that the melt flow is not too low and that the material is of constant quality.

#### 4.4 Quality assurance and distribution

The last part of the operational process consists of quality assurance, packaging of products and distribution of products to customers.

##### **Quality control**

When designing new products, quality of products is checked and confirmed by multiple people within the company and possibly also by the customer. If this is approved, products may be manufactured with the new mould. During manufacturing, products are always tested twice per shift, and tested products are kept for three months. To increase efficiency of quality control, more and more cameras are used for quality checks. These cameras check for instance if the correct label is used and if it is in the correct position.

Quality control becomes more challenging due to varying customer requirements. Some customers attach less value to quality of products than others, and some only consider quality to be important if the product is in stock. But if there is a shortage of a material from a certain quality, then a lower quality will also be accepted. Hence, it can be confusing for production employees if

sometimes it is okay to have a film on the product, whereas other times such products should be disposed of. Furthermore, quality is less of an issue for single-use products. If products will be intended for multiple use, quality becomes more and more important.

The thin-walled products of Haval require the mould, machine and material all to be in top conditions. If there is a minor disturbance in one of them, quality problems immediately arise. An advantage of injection moulding is that the process is very consistent. If the first few products are of sufficient quality this will usually stay so.

*“The mould, machine and material must all be good. As soon as one of the three has a minor disturbance, you immediately have quality problems.”*

*- Ron Kastermans, production manager at Haval*

The weakest point of disposable products is their high fragility. A balance has to be found between producing as quickly as possible with minimum materials, but on the edge of what is technically feasible. As an example, yogurt buckets are now much more flexible and have thinner and smaller edges than a few years ago. This comes along with less stability of the product. The weight of the buckets has decreased from 36g to 28g, and customers are even asking to go to 24g. The question then becomes: “How low can you go until the functionality is not sufficient anymore?”

### **Packaging products**

After producing the products and doing a quality check, products are stacked and are then packaged manually.

### **Distribution**

After packaging the products, they are delivered to the customer. Products are not produced until ordered by customers.



## 5. Conclusion and recommendations

Based on the outputs derived from all three interviews with Haval, strengths of the business model and operational process in regards to circularity are identified, barriers and enablers for circularity are summarised, and opportunities for circularity are described.

### 5.1 Strengths for circularity

#### **Business model**

Haval is facing a major challenge due to the introduction of the single-use plastic (SUP) directive, going into effect on the 3<sup>rd</sup> of July this year. This regulation will ban most of the plastic products Haval is currently producing (plastic cutlery, coffee stirrers, plates etc.), which has a significant impact on the company's business. Instead of going for easy solutions to circumvent the rules (by using other materials), Haval decided to take an entirely different approach, undergoing a transition from single-use to multiple-use products. Next to producing products, Haval intends to offer a complete service with its new business model, including delivery, collection and cleaning of products between each of their uses. This includes positioning of products where customers pay per usage of the product, rather than focussing on individual product sales. Moreover, it presents an opportunity to further expand Haval's product range. A specific product line (called 'Circulware') is recently created for events and festivals, including reusable food trays and chips trays.

#### **Circular strategies in the value chain**

The new business model that focusses on reusability as part of a service offering is still being further developed and tested by Haval, and the final approach has yet to be determined. The implementation may for example include: an option for washing and sanitising products by Haval, the introduction of a certain fee if products are not returned rather than charging deposits, or the collection of products at end-of-life for recycling. Reusability and product take-back are further tested in pilot projects.

Furthermore, Haval is actively researching the use of watermarks, which may (in the future) allow for sorting between food and non-food products. Food grade regulations limit the use of PCR for Haval. However, Haval is currently starting a pilot to see if they can re-apply their production waste (PIR) for manufacturing new products.

#### **Operational process**

Haval's previous business model used to be entirely focussed on producing high volumes, at the lowest possible cost. However, focus will no longer be placed on reducing materials for cost efficiency. It is rather placed on improving product designs to increase durability and allow for reusability, while using as little raw materials as possible per use of the product. This involves strengthening products by using additional material (from 2g to 6-8g for cutlery) and improving product designs (extra edges on sides, rounder shapes etc.), but can also involve using fillers (special PP blend of Haval). A balance needs to be found between limiting material usage, while still using enough material for the product's functionality.

Haval's disposable products were previously made from PS, which is now being replaced with PP for the multiple-use products. This change of materials also requires other moulds. Once the

production process has started, the quality of the product also remains constant. In the end it is the combination of material, mould and machine that determines the quality of the end product. The thin-walled products of Haval require all three to be in top conditions to avoid quality problems. For materials this means a high melt flow, high stiffness and constant quality of the material. Nonetheless, product quality is difficult to regulate due to varying quality requirements of customers.

## 5.2 Barriers and enablers for circularity

To ensure circularity for Haval and its value chain, several barriers and enablers can be pointed out. The biggest barrier for Haval at this moment is the uncertainty of SUP regulations in the Netherlands. Although the SUP directive is introduced on a European level, and it is clear that regulations will have to go into effect on the 3<sup>rd</sup> of July 2021, on a national level it is not defined which exacts measures will apply in the Netherlands. This prevents Haval from taking clear decisions and causes a delay in investments. In line with this, the biggest enabler for Haval is clear governmental regulations. This also includes more specific measures regarding return systems and waste separation. Other barriers and enablers have been mentioned and explained before and are summarised in table 3 below.

**Table 3: Barriers and enablers for enabling circularity at Haval**

<b>Barriers</b>	<b>Enablers</b>
<ul style="list-style-type: none"> <li>• Some products not suitable for multiple-use</li> <li>• Time for setting up new business model</li> <li>• Setting up reverse logistics takes time</li> <li>• Collection of products after usage</li> <li>• Washing is more expensive than producing new product</li> <li>• No fixed definitions on reusability</li> <li>• Uncertainties of SUP regulations in NL</li> <li>• Differences in the implementation of directives per country</li> <li>• Plastic plates are banned, trays not</li> <li>• Restriction of rPP for food purposes</li> <li>• Chemically recycled materials taken by larger companies</li> <li>• Additives for strength limit recycling possibilities</li> <li>• Large mixing silos needed for more constant batch</li> <li>• IML PIR waste is not food grade</li> <li>• Pollution of PIR with dust etc.</li> <li>• Increasing virgin material prices (force majeure)</li> <li>• Limited availability of materials (force majeure)</li> </ul>	<ul style="list-style-type: none"> <li>• Entirely new business model</li> <li>• Expansion of product range due to SUP directive</li> <li>• Specific legislation and regulations</li> <li>• More specific measures from the government regarding return systems and waste separation</li> <li>• Uniformity in terms of collection, waste separation and material requirements</li> <li>• Pilot projects to test what works (reusability and product returns)</li> <li>• Use of watermarks to improve recyclability</li> <li>• More efficient sorting</li> <li>• Distinguish between food and non-food during sorting</li> <li>• High quality (foodgrade) recycled materials</li> <li>• Food grade PIR waste due to controlled process</li> <li>• Constant quality of PIR with sufficient melt flow</li> <li>• Design for circularity and recycling</li> <li>• Use of fillers for strength</li> <li>• Not charging consumers any additional costs with reusable products</li> </ul>

<ul style="list-style-type: none"> <li>• Boost in sales for take-away and delivery due to Covid-19</li> <li>• Varying quality criteria of different customers</li> <li>• Thin-walled products require top conditions</li> <li>• High fragility of disposables (light weight)</li> </ul>	<ul style="list-style-type: none"> <li>• Separate collection to allow for food grade recycled materials</li> <li>• Customer request for sustainable options</li> <li>• Project grants</li> <li>• Cooperation with others</li> </ul>
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### 5.3 Opportunities for circularity

Because Haval is currently further developing and testing its new business model, there are still many options to consider to further enhance circularity within the company.

#### Access and reuse

The new business model of Haval will be focussed on reusability and offering products as part of a service. The intention of Haval is to offer an option for washing and sanitising products to be done by either Haval or the customer itself. Collection and delivery of products may be different depending on the type of customer (e.g. all products at a festival are sold in same container and used by all the different food stands, whereas delivery and collection of products to restaurants may happen through warehouses or individual locations). Moreover, collection of products from consumers is regarded to be challenging for all reuse models. Haval is exploring possibilities for the introduction of a certain fee if products are not returned rather than charging deposits. Nationwide collection points may also be an option, but these should be arranged on a wider scale so other companies could also participate in this. Hence, Haval is further exploring the possibilities to effectively introduce the *reuse* and *access* strategy.

#### Product take-back

Strategies such as remanufacture, refurbish and repair are not applied by Haval because it is often much cheaper to produce new products. Broken or damaged products that have reached end-of-life may then be used as input for recycling. The idea is to collect products when they break or get damaged, and recycle their materials to be used as input for manufacturing new products.

#### Resource recovery and design for recyclability

The recyclability of Haval's products is questionable due to many products being too small for sorting, and because of the use of additives in Haval's blend (because additives limit application possibilities of recycled materials since a homogenous PP is often preferred). If the PP blend is only used for multiple-use products, and these products are separately collected by Haval, additives do not present a problem anymore, because the material can be reused for Haval's products and does not mix with homogenous PP. Separate collection also presents opportunities to re-apply the recycled materials for food products, because of separate collection and a controlled process. This way it can be demonstrated that the material has previously been used for food purposes.

To further enhance recyclability of Haval's products in recycling installations, the company is actively researching the use of watermarks, which may (in the future) allow for sorting between food and non-food products.

### **Use of recycled materials**

Although the use of PCR from household waste is limited because of food safety regulations, opportunities present itself to re-apply waste of Haval's production process (PIR) for the manufacturing of new products. Haval is currently starting a pilot project to further test and implement this.

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## About the project

The problems associated with plastic waste and in particular its adverse impacts on the environment are gaining importance and attention in politics, economics, science and the media. Although plastic is widely used and millions of plastic products are manufactured each year, only 30% of total plastic waste is collected for recycling. Since demand for plastic is expected to increase in the coming years, whilst resources are further depleted, it is important to utilise plastic waste in a resourceful way.

TRANSFORM-CE aims to convert single-use plastic waste into valuable new products. The project intends to divert an estimated 2,580 tonnes of plastic between 2020 and 2023. Two pilot plants will be set up, one in Almere (NL) and one in the UK. The plants will make use of two innovative technologies – intrusion-extrusion moulding (IEM) and additive manufacturing (AM) – to turn plastic waste into recycled feedstock and new products.

Moreover, the project will help to increase the adoption of technology and uptake of recycled feedstock by businesses. This will be promoted through research into the current and future supply of single-use plastic waste from municipal sources, technical information on the materials and recycling processes, and circular business models. In-depth support will also be provided to a range of businesses across North-West Europe, whilst the insights generated through TRANSFORM-CE will be consolidated into an EU Plastic Circular Economy Roadmap to provide wider businesses with the 'know-how' necessary to replicate and up-scale the developed solutions.

### Lead partner organisation

Manchester Metropolitan University

### Partner organisations

Materia Nova

Social Environmental and Economic Solutions (SOENECS)

Ltd

Gemeente Almere

Save Plastics

Technische Universiteit Delft

Hogeschool Utrecht

Hochschule Trier Umwelt-Campus Birkenfeld Institut für angewandtes Stoffstrommanagement (IfaS)

bCircular GmbH

Viridor Waste Management Limited

### Countries

UK | BE | NL | DE

### Timeline

2019-2023