Circular kitchen appliances: Designing an induction hob fit for repair and remanufacturing

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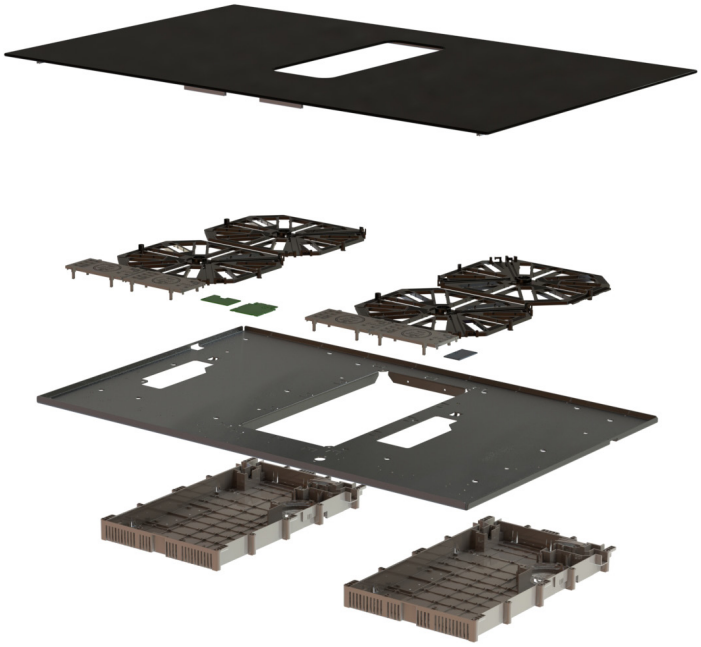
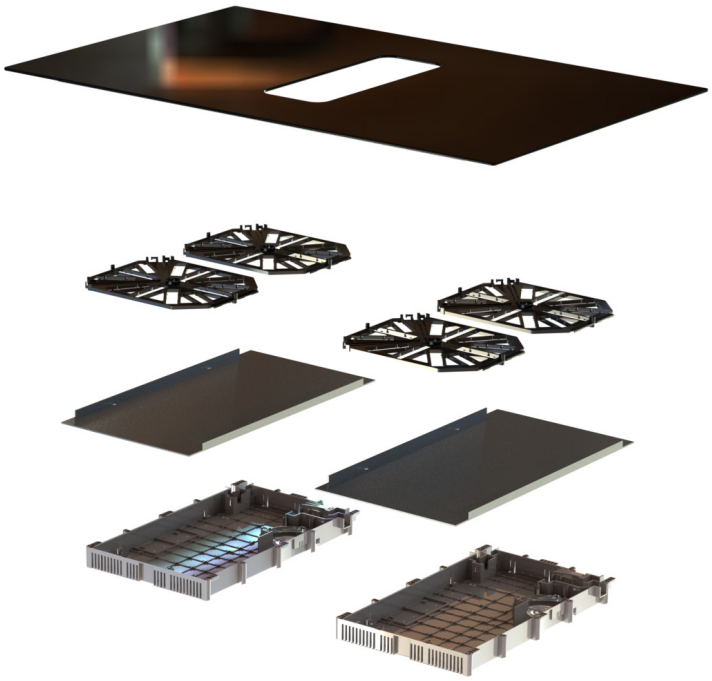
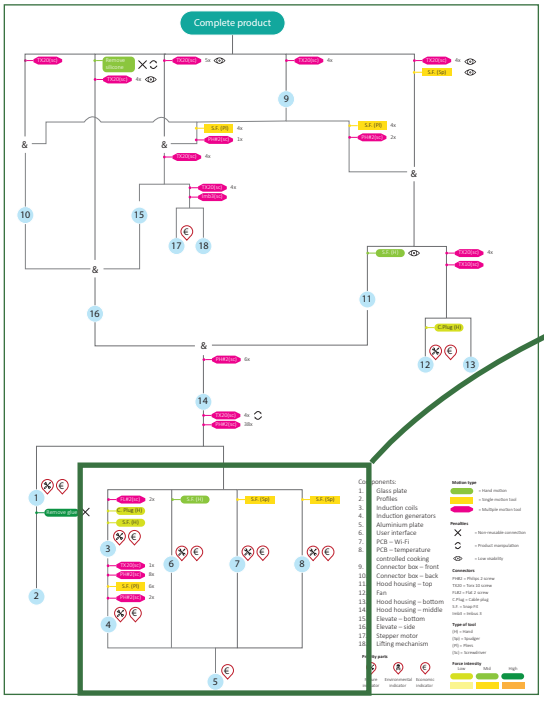
Cover picture: ATAG Hood in Hob premium elevate (HIDD28471SV | ElevateTM iInduction hob with integrated extractor hood, black (83cm), n.d.)



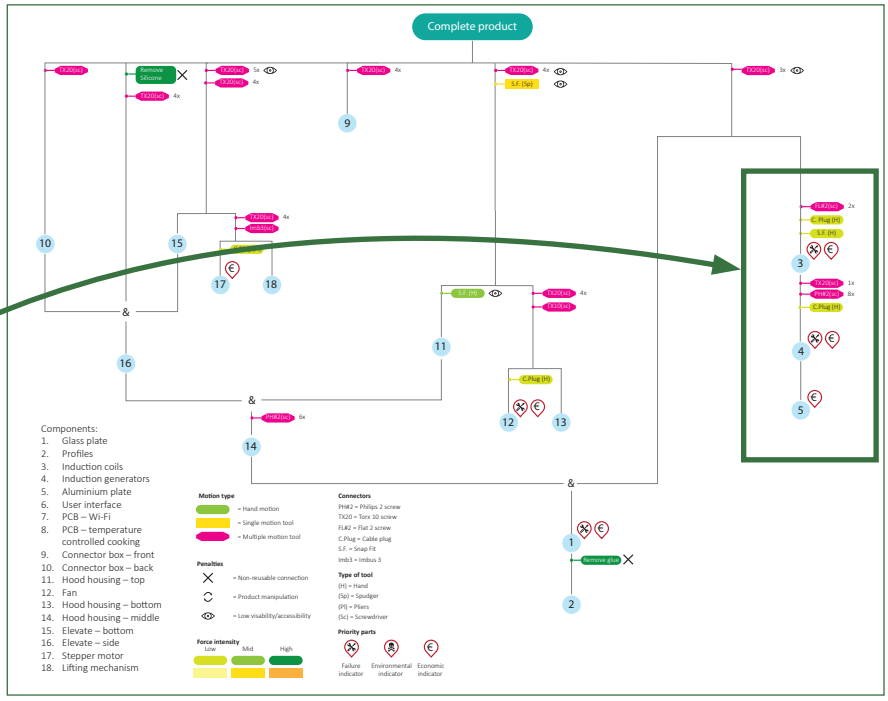
Current design Hood-in-Hob Elevate™
Induction assembly and user interface



New design Hood in Hob
Induction assembly



Current disassembly map



New disassembly map

Executive Summary

Context

The amount of electronic waste keeps growing, half of which is white goods. In the meantime a transition from gas hobs to induction hobs is taking place. Induction hob have a shorter lifetime and contain more valuable materials. As a consequence, the induction hob e-waste will increase significantly.

To prevent a further increase of e-waste by this growing amount of induction hobs, a circular product is proposed. In this graduation project an induction hob is designed that is fit for the circular economy. Here the focus is on the inner three circles of the Rainbow Model.
For this project the Hood-in-Hob Elevate™ from ATAG Benelux was researched and redesigned.

Research

Research was done into the architecture of the current product, identifying the priority parts and how easily the product can be disassembled. It was concluded that most of the priority parts were located in the induction assembly, which is the part of the product that is hardest to reach. The main reason for it being hard to reach is because the product needs to be taken out of the countertop, which brings multiple complications with it.

Next research into consumer behaviour was done, to gain insight into the product care the consumer performs, the reason of product replacement and the user's attitude towards refurbished products. It was found that the product was almost never replaced because of technical obsolescence, but because of psychological and functional obsolescence. In order to avoid this type of product replacement, it should be designed for upgradability and remanufacturing. To support this, the product should be easy to disassemble.
It was also found that the only product care the consumer performs is the cleaning of the product. Lastly it was found that the consumer is prepared to buy a refurbished product provided, if the expected lifetime is the same as a new one and if the product is thoroughly cleaned.

Concept

The result of the project is a concept of an induction hob that is fit for a circular economy. The main change compared to the current product is the architecture of the concept.
The induction assembly is changed into two separate modules, which can be disassembled without removing the glass plate from the countertop. The disassembly has been simplified so much, that the consumers are able to replace the induction module by themselves. They can send the module to ATAG for repair, making the repair process faster and using the time of the service engineer more efficient.
Finally, the user interface has been taken out of the product and made into a separate product. The user interface was one of the priority parts which were most difficult to disassemble. By making it separate, it is easier to reach. On top of that the upgradability has been improved this way, there is more upgrade flexibility and no changes to the rest of the product are required.
To conclude the design recommendations are made for detailing the concept even further.

This project set out to design a product that is fit for the circular economy. The outcome is a concept of a product that is easier to disassemble and thus easier to repair, upgrade and remanufacture.

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1. Introduction

In this chapter the goal and main research questions of this thesis will be presented. It covers the context, the assignment, the company and the approach.

1.1 Context

The current market of white goods has a linear consumption model. Appliances are bought, used and disposed of, creating a lot of e-waste. This linear behaviour has a major impact on the environment, as a result of this the EU has as a target to reduce e-waste (Circular economy action plan, n.d.).
In addition to this the Dutch government has a target to reduce the amount of raw materials with 50% by 2030 and have a waste free economy by 2050. (Ministerie van Infrastructuur en Waterstaat, 2023b)
In order to meet these targets, it is necessary to switch to a circular economy. A complete circular economy eliminates waste completely, and reduces the need for extracting raw materials.

1.1.1. E-waste

The world is faced with a alarming growth of e-waste. At the end of the life cycle of a product not all materials are recovered for recycling and valuable materials are lost forever (Milieu Centraal, n.d.). On top of that e-waste can contain harmful materials, all the more reason to prevent creating it.

E-waste growth

Over the years the amount of EEE (Electronic and Electric Equipment) has only been growing. In the years 2014 to 2021 the amount of white goods has doubled, from 125.912 tons to 252.002 tons (Nationaal (W)EEE register, 2022). Also, the amount of white goods waste has grown and it almost doubled from 44.566 tons in 2014 to 93.056 tons in 2021. This is only the amount collected, which is estimated to be only 47% of the total amount of white goods waste in 2021.

E-waste collection

In order to utilize the e-waste usefully it needs to be collected and end up in the right place. Since 2012 producers and importers of EEE are held responsible for the collection of e-waste (Producentenverantwoordelijkheid, de Europese richtlijnen - Weee Nederland, 2022). Collection systems are also already in place: sellers of EEE are obliged to take back old equipment.

Figure 1: ATAG Hood in Hob premium elevate (HIDD28471SV | ElevateTM Induction hob with integrated extractor hood, black (83cm), n.d.)

1.1.2 Circular economy

In order to change the linear way of consumption: taking materials, making product, using it and throwing the product away, the circular economy is proposed (Circular economy introduction, n.d.). In the case of e-waste, the circular economy can minimize the amount of e-waste and use of raw materials for white goods. This can be achieved by extending the product lifespan and reusing the waste as raw material.

A design tool for the circular economy is the adapted butterfly diagram, the rainbow, from Bakker & Balkenende (2021). When a product is produced value is added with each step: a part is more valuable than a material and a product is more valuable than a part. In the rainbow diagram the smaller the circle is, the more value is retained. The biggest circle brings the product back to its least valuable form.

In this project the focus will be on the integrity of the product, over the materials. Only the inner circles of the rainbow diagram will be taken into account: maintenance, reuse and remanufacturing. These inner circles retain the most functions and value of the original product.

1.1.3 Consumer

It is important to include the consumer in the design: a design can be completely circular, but if it is not taken in use by the consumer, it is worthless. 8 out of 10 EU citizens say they find sustainability important when buying a product ("Europeans' attitudes towards the issue of sustainable consumption and production Analytical report", 2009). However, 60% of people say they know little to nothing about the impact their product has on the environment. On top of that the majority of consumers find the price and the quality of a product more important than the environmental impact when buying a product. The design must be circular, but not at the expense of the quality and the price of the product.

Also, it is common practice with kitchen appliances that they are replaced before their end of life, together with the whole kitchen (ATAG, personal communication, November 2022). This is why consumer behaviour is also important to take into account, since the appliances are not replaced because of technical failure.

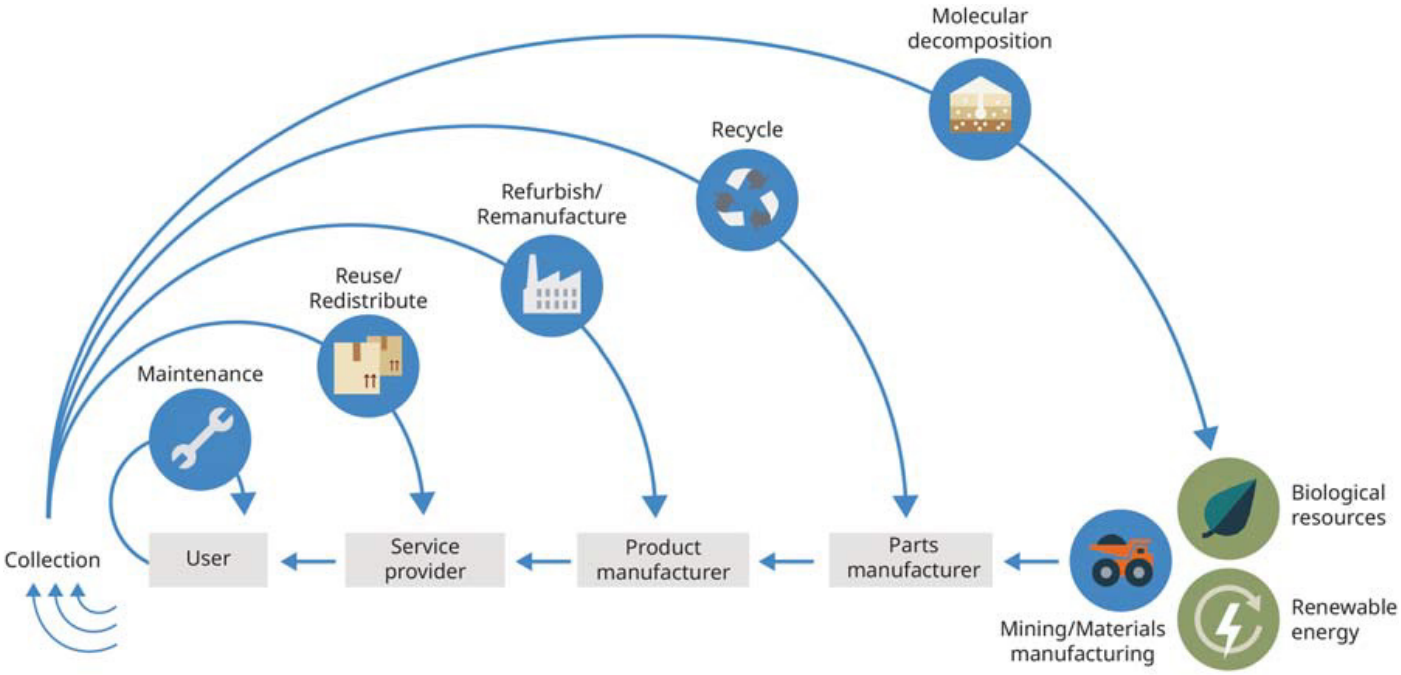


Figure 2: Adapted butterfly diagram, rainbow, (Bakker & Balkenende, 2021)

1.2 Assignment

This graduation project investigates how kitchen appliances can be made fit for a circular economy, using an induction hob with integrated hood from the brand ATAG as a showcase. The design of the Hood-in-Hob Elevate™ will mainly focus on repairability and remanufacturing options in combination with consumer behaviour.

1.2.1 Research questions

The research question of the project is: How can an induction hob be designed to be fit for the circular economy? In order to answer this question, the following sub-questions need to be answered. Here they are ordered based on the rainbow diagram, going from inner to outer circles.

1. To what extent does the user perform product care?
2. How easily can the product be disassembled?
3. What is the main reason for product replacement?
4. What is the attitude of the user towards refurbished product?
5. What are the priority parts?

1.2.2 ATAG Benelux

This project will be done with ATAG Benelux, they represent 5 brands within the Benelux. ATAG Benelux is part of the Hisense group since 2018. For this project an induction hob of the ATAG brand is used, ATAG is the premium brand of ATAG Benelux.

For this project the Hood-in-Hob Elevate™ (HIH) is taken as a starting point, this is their latest product which has been launched last year. It is an induction hob with an integrated hood, which has an elevating tower to bring the extraction inlet closer to the rim of the pan. The hob also has temperature-controlled cooking, which can be used in combination with a normal pan, a normal pan with a temperature probe or a pan with an integrated thermometer. The Research & Development, the design of the HIH as well as the servicing is done by ATAG Benelux in Duiven, the production takes place at a Hisense production plant located in Slovenia.

Figure 3: ATAG Hood in Hob premium elevate (HIDD28471SV | ElevateTM Induction hob with integrated extractor hood, black (83cm), n.d.)

1.3 Approach

For the project the double diamond approach will be used. The project consists of 2 main parts: research and design.

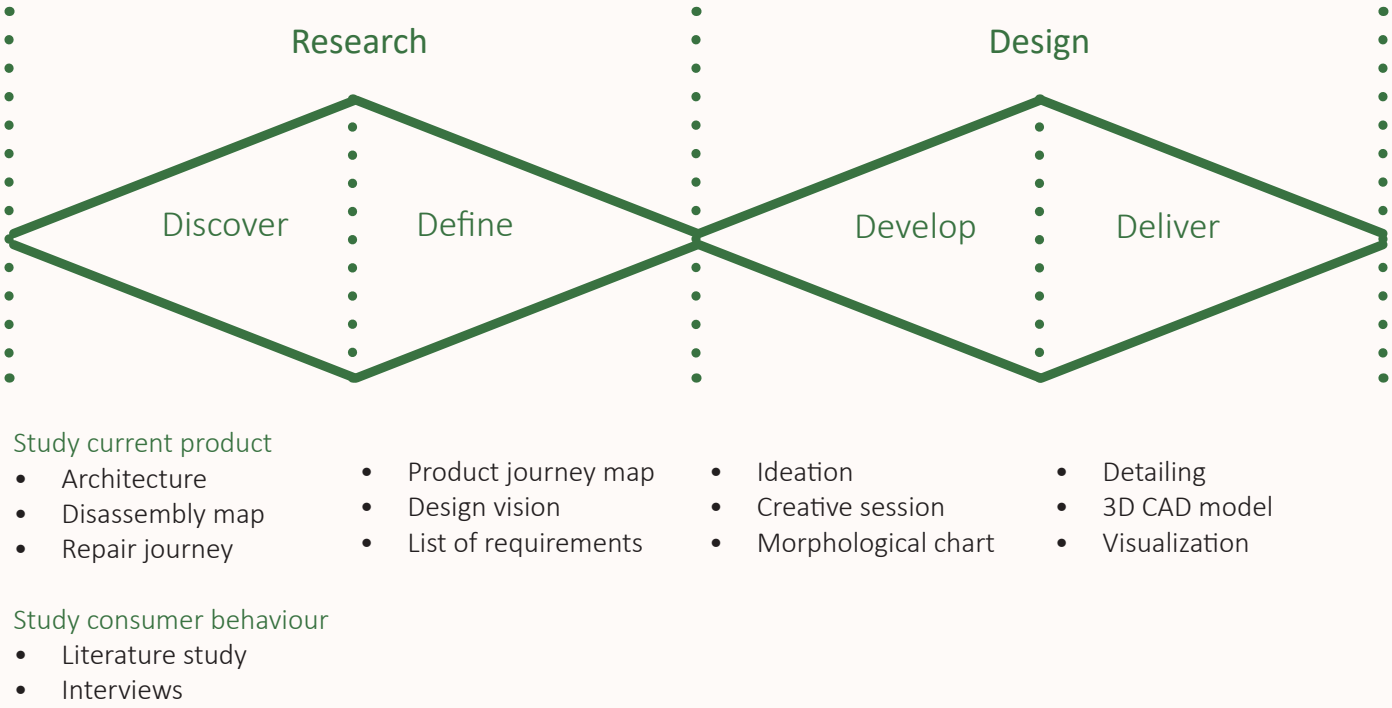


Figure 4: Double diamond

Research question	Method
5. What are the priority parts?	Disassembly map and interviews
2. How easily can the product be disassembled?	Disassembly map and interviews
3. What is the main reason for product replacement?	Interviews
1. To what extent does the user perform product care?	Literature study and interviews
4. What is the attitude of the user towards refurbished product?	Literature study and interviews

Table 1: research questions and methods

In the research phase the product was researched: what is its architecture, what are the priority parts and to what extend can it be repaired. Next to that, research was done into the consumer behaviour around the product care, replacement of the product and the attitude towards refurbished kitchen appliances. At the end of the research phase the insights were used to form a design vision and make a list of requirements for the design phase.

In the design phase the design vision was used as guidance in ideation and a creative session in which a quantity of ideas was generated. These ideas were translated into concepts with the use of a morphological chart. At the end the most suitable concept was detailed and visualized.

2. Current product architecture

In this chapter the following research questions are answered: 5. What are the priority parts? 2. How easily can the product be disassembled?
This is done using a disassembly map, determining the priority parts and the amount of steps needed to reach these parts. To also gain insight in how disassembly is in practice, the product repair journey is mapped.

2.1 Bill of components

The bill of components was obtained by a combination of disassembling the product and information provided by ATAG. It presents the assemblies of the product and provides a first understanding of the architecture of the product.

#	Assembly	Parts/subassemblies	Materials
1	Induction	2 induction generators	Electronics, plastic housing
		Metal support plate	Aluminium
		4 coils	Electronics, copper
		5 user interface PCB	Electronics
		WIFI and Temperature controlled cooking PCB	Electronics
2	Glass	Glass plate	Glass
		Profiles	Aluminium
3	Hood	Hood body	Plastic
		Seals	Rubber
		2 fan motors	Electronics, metal fans
4	Connector box	Housing	Plastic and metal
		Power supply	PCB
		Fan control	PCB
5	Translation module	Stepper motor	Electronics
		Lifting mechanism	Metal
6	Tower		Plastic and glass

Table 2: Bill of components

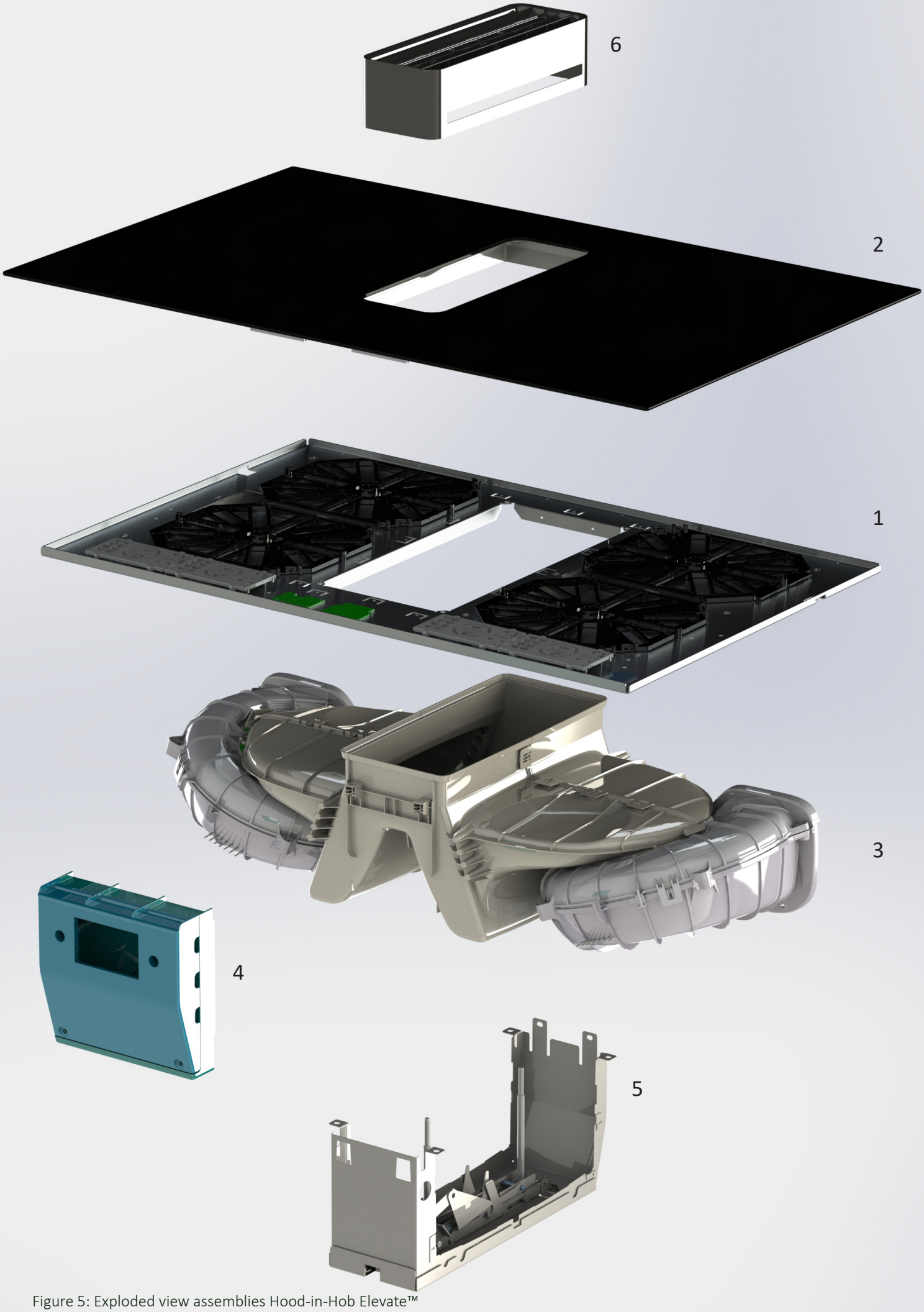


Figure 5: Exploded view assemblies Hood-in-Hob Elevate™

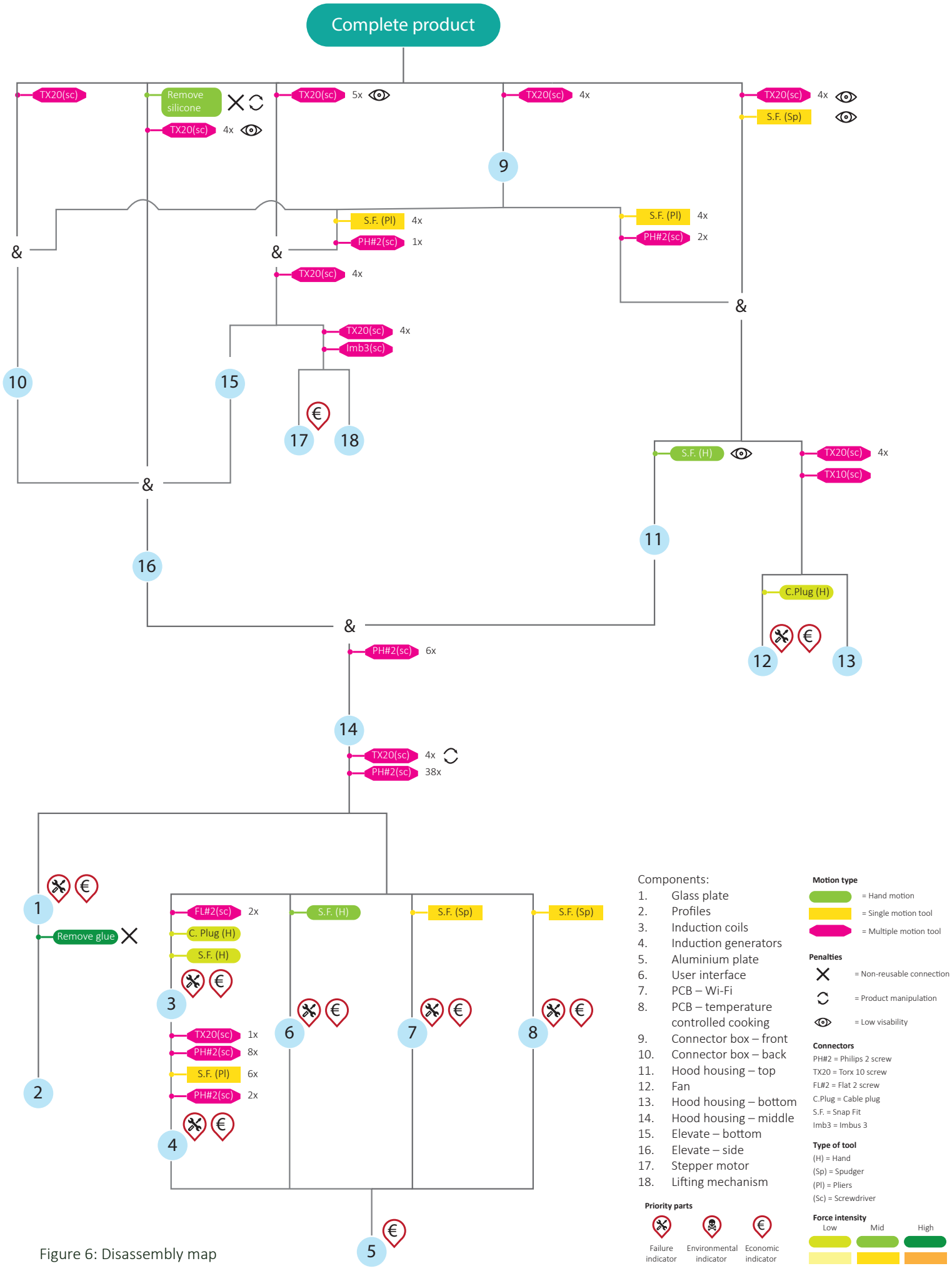


Figure 6: Disassembly map

2.2 Priority parts

To map the priority parts a disassembly map was used (De Fazio et al., 2021). The disassembly map shows the number of steps it takes to reach a part, the difficulty of the steps and which parts are most likely to fail, have economic value or have environmental impact.

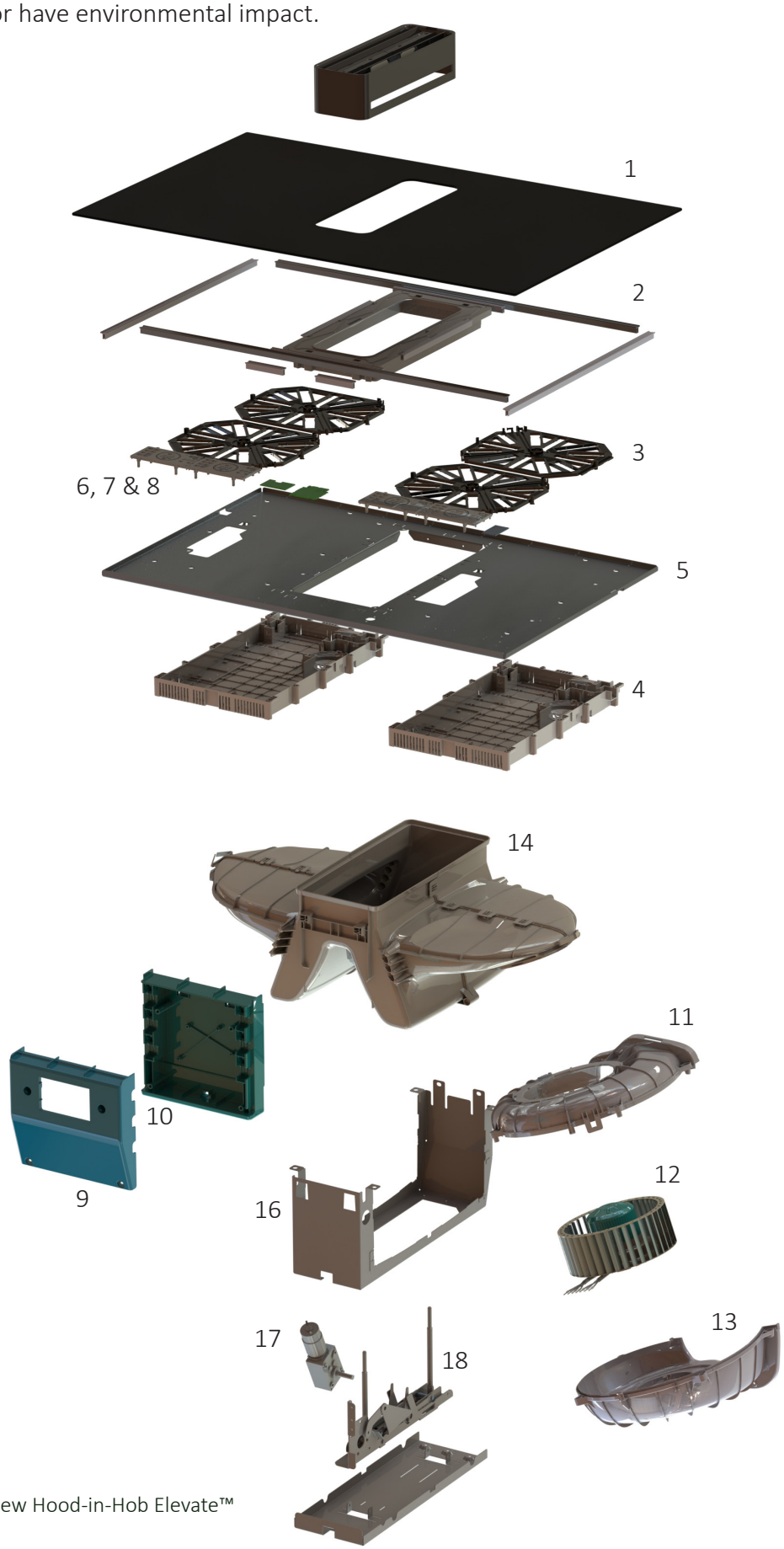


Figure 7: Exploded view Hood-in-Hob Elevate™

Risk of failure

The Quality Assurance of ATAG helped with determining which parts have the biggest risk of failure. The product was launched only recently and the oldest test product is in use for one and a half years, there is no long term data available on this specific product. However, based on other induction hobs from ATAG assumptions can be made.

The induction coil, generators, fans, user interface, WiFi and temperature-controlled cooking PCB are expected to break down over time. Apart from the fans, all these parts are located in the induction assembly and so need the most steps to disassemble. The glass plate also has risk of failure, not over time but in transport, by user error or whilst performing repair.

Economic value

The R&D team shared the purchase price of the parts, which were used to determine the parts with high economic value. There was a wide range in the price of the parts, this is represented with a scale from little economic impact (€) to high economic value (€€€). The part with the highest economic value is the glass plate, followed by Induction generator, induction coils and the user interface.

Environment impact

The parts with the biggest environmental impact are a bit more difficult to determine, however it can be assumed that the parts with the biggest economic value also have the biggest environmental impact. This is because the amount of energy put in to the part corresponds with both money and environmental impact. For this reason the parts with the biggest environmental impact are not indicated on the map and can be assumed to be the same as the parts with the highest economic value.

#	Part	Nr. of steps to reach	Reason of priority	Details
1	Glass plate	11	Risk of failure	During transport and in life because of user error
			Economic value	€€€
			Environmental impact	
4	Induction generator	13	Risk of failure	
			Economic value	€€
			Environmental impact	
3	Induction coil	12	Risk of failure	After long term use
			Economic value	€€
			Environmental impact	
8	Wifi PCB	12	Risk of failure	
			Economic value	€
			Environmental impact	
7	Temperature controlled cooking PCB	12	Risk of failure	
			Economic value	€
			Environmental impact	
6	User interface	12	Risk of failure	
			Economic value	€
			Environmental impact	
12	Fan	5	Risk of failure	Long term after wear and tear
			Economic value	€€
			Environmental impact	
17	Stepper moter elevate	5	Economic value	€

Table 3: Priority parts

2.3 Product repair journey

To add to the theoretical disassembly of the product, it was also researched how product repair is done in practice currently. The information was collected by observing a service engineer for a day in the field, doing a semi structured interviews with the head service engineer about diagnosing the HIH and what is considered easy or difficult in terms of repair and lastly a repair demonstration on the HIH by the head service engineer.

2.3.1 Warranty

Each ATAG product has 2 years of full warranty, after which it has an additional 6 years partial warranty. The partial warranty means that the customer pays €99,- per visit, while there is no charge for materials and labour.

Since January first 2023 ATAG switched to another warranty period. The warranty is now the expected product lifetime. This swich is made recently and it is not clear yet how ATAG implements it, for example they do not know what the expected product lifetime is.

Parts are in stock for at least 15 years after the last product is sold, so even after warranty has expired, consumers can still obtain spare parts. After the 15 years customers are still free to call for spare parts, but there is a risk that the part is no longer available.

2.3.2 Repair request

The consumer contacts ATAG to request a repair via the website. At that moment the consumer is asked to give details of the symptoms. If this first description is not enough, the consumer is contacted by phone. Based on the description of the symptoms and, if available, error codes, ATAG makes an assumption of what needs to be repaired. They choose the components that are most likely needed to make the repair and send them to the service engineer.

Each service engineer visits around 6 to 9 clients per day, for the repair of an induction hob 35 minutes are allotted. Most repairs are done by service engineers from ATAG, but there is a shortage of service engineers so some repairs are done by third parties via ATAG. The repairs are performed at the home of the consumer and after the repair the product is reinstalled. Replaced components are recycled, unless ATAG's quality assurance has expressly stated if that specific part should be collected to be inspected. In order to prevent needing to go back the engineer often replaces a part 'just in case'. Often a failure of the product can have multiple causes and the service engineer has gotten components to fix all of those causes. It is less expensive to be sure and replace both components, than to coming back for a second repair.

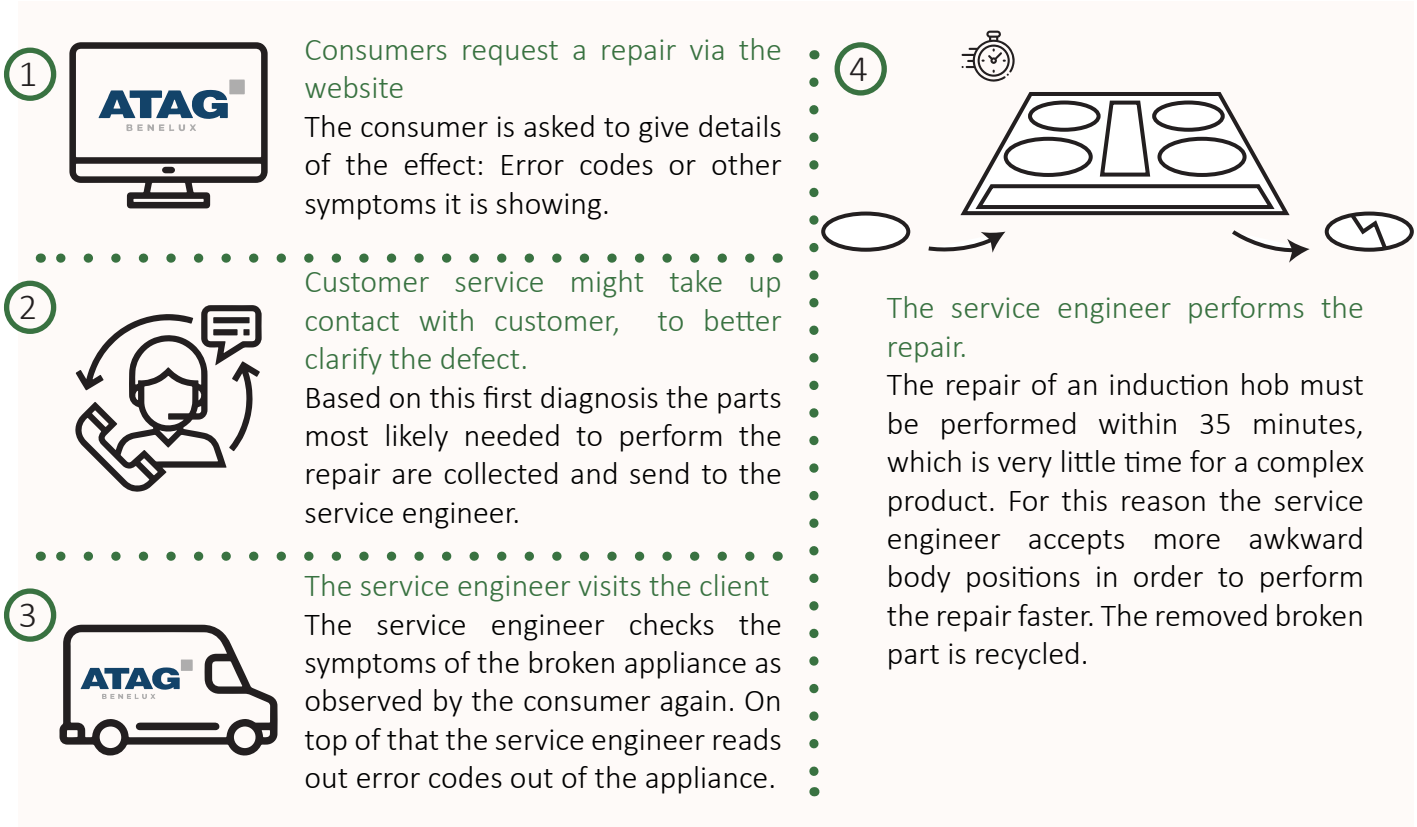
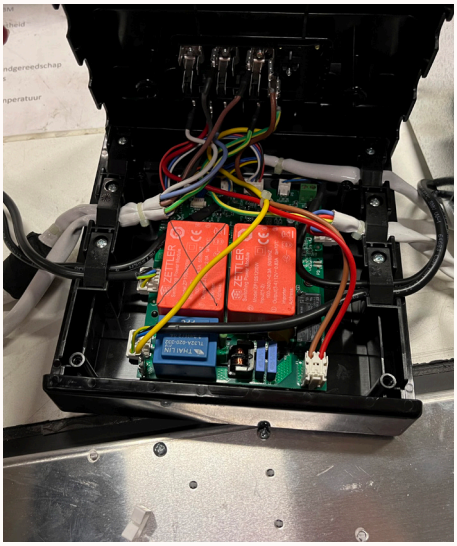


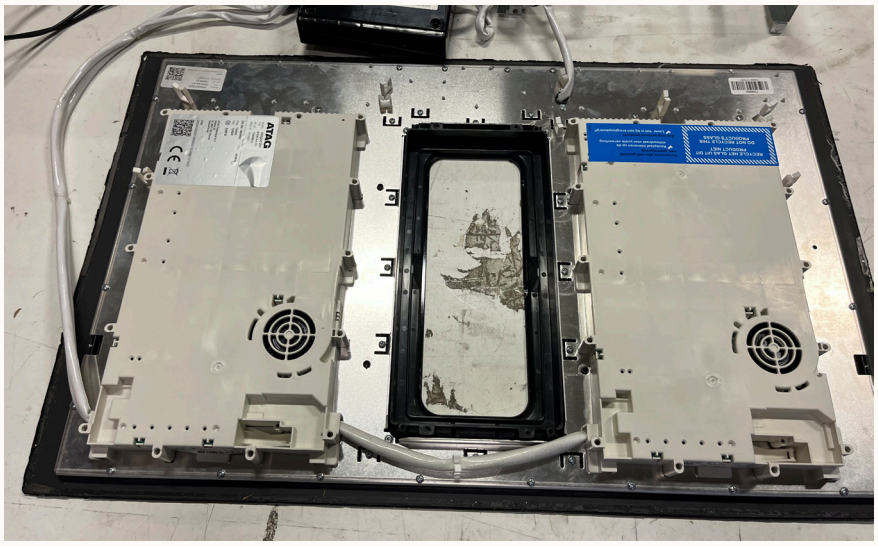
Figure 8: Repair request

The bottom of the HIH, when it is taken out of the countertop. On the edges silicone residue can be seen, which needs to be removed before reinstalling.

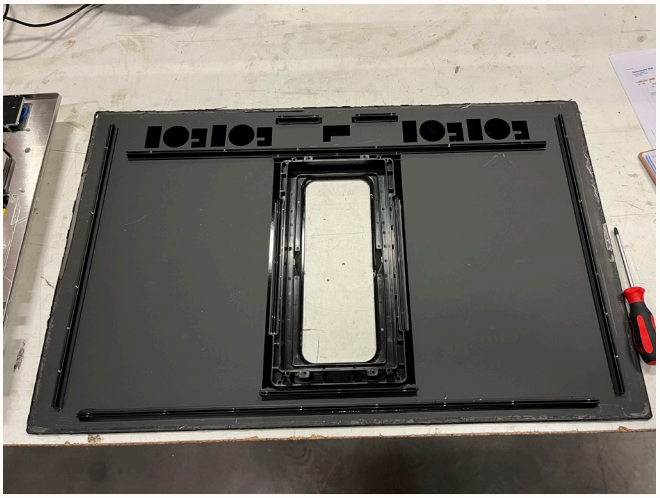


The connector box needs to be opened in order to disconnect the cables.

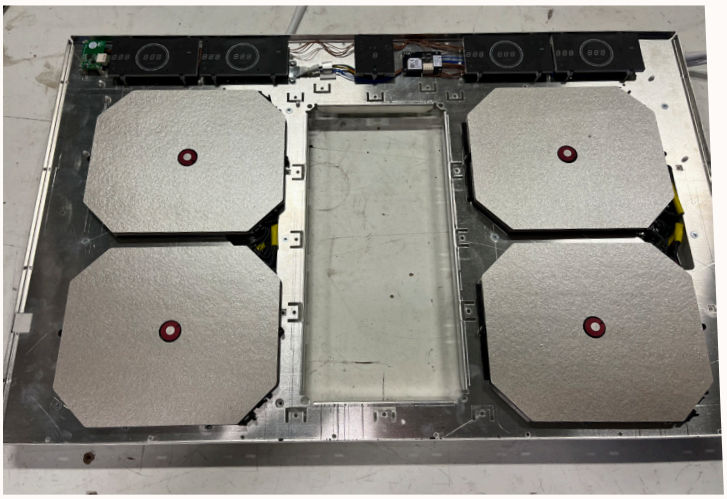
The connector box, the elevate and the hood assembly need to be removed before the induction assembly can be reached.



The last part to be removed is the glass plate, for this 42 screws need to be removed and it needs to be turned around.



Leaving the glass plate with the strips glued to it.



Now the user interface and the induction coils can be removed. After the coils are removed, the induction generator can be removed last.

Figure 9: How to perform a repair of a part in the induction assembly

2.3.3 Repair

Diagnosis

The service engineer always starts with talking to the consumer: What are the symptoms the product is showing? Did something happen? Did the product make any sounds? Did they see if the product gave error codes at the time? This way the service engineer forms a first impression of what needs to be done.
The main indicator to the cause of the defect are error codes. These error codes point to one or two possible causes of the product failure. Some of the error codes are described in the user manual. Sometimes with an action the user is expected to be able to check themselves, sometimes the cause is mentioned with the instruction to contact the service engineer. Other error codes are only available for the service engineers.

Performing repair

According to the head service engineer no repair is difficult to perform, it depends on the complexity of the product and the time allotted. As mentioned, that is only 35 minutes, which is very little time for a complex product like the HIH. The product is complex because of the number of parts and the architecture. Most connections are screws and some snap fits. Almost all the screws are torx or Philips and some slotted. Low to medium amount of force is needed for the disassembly.
Depending on the location of the failed part, the hob needs to be taken out of the countertop or can be serviced from the bottom. If the hob is taken out the visual and manual access is better, however the risk of damage to the glass plate of the hob or the countertop is high. On top of that the silicone that is used to secure the glass plate in place needs to be cut lose. Afterwards the old silicone remains need to be cleaned from the glass plate and countertop and the silicone reapplied. The hob needs to be taken out for all repairs in the induction and user interface.
Repairs that can be performed from the bottom are the fans, the power supply and the translation module. These repairs can be performed faster, however the service engineer needs to work within the kitchen cabinet. Either laying on his back or sitting on his knees in the cabinet, as shown in figure 10.

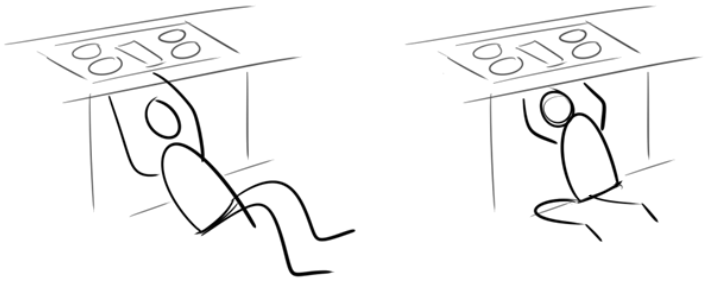


Figure 10: Positions in which a repair is done within a kitchen cabinet

2.4 Conclusions

What are the priority parts?

Most of the priority parts can be found in the induction assembly. The parts with the highest failure risk and economic value are the same. They are assumed to also be the parts with the biggest environmental impact.

How easily can the product be disassembled?

Not all parts are easily accessible. The product can be disassembled mostly with the exception of the profiles glued to the glass plate. Parts that can be replaced from the bottom have bad visual and manual access, but the repair can be performed faster. Parts for which the hob needs to be taken out of the countertop take much more time to be replaced. Also, there is a higher chance of damage to the glass plate or the counter top, it is awkward handling the product alone and much space is needed for the repair.

Design take aways

- The priority parts must be within easy reach: a maximum of 4 simple steps.
- All parts must be replaceable without removing the glass plate from the countertop.
- The replacement of part ‘just in case’ must be avoided.
- The time of the service engineer must be used efficiently, preferably on performing repairs and not on travel.
- The replacement of any part must be performable within 30 minutes.

3. Consumer behaviour

In this chapter the following research questions will be answered:

1. To what extent does the user perform product care?
3. What is the main reason for product replacement?
4. What is the attitude of the user towards refurbished product?

3.1 Method

3.1.1 Literature research

In order to get useful insights into consumer behaviour a literature research was performed. The starting point were 4 articles. From there on via snowballing more relevant articles were found. A total of 22 papers were collected, of which 12 proved relevant to the topic. They covered the subject of consumer behaviour in terms of product care, product repair, product replacement and the acceptance of refurbished products. The other 10 paper strayed too far from the original topic of consumer behaviour, for example the optimal lifespan of a product based on energy use.
Insights from the literature study were used to formulate interview questions, in order to determine which information was applicable to the product.

3.1.2 Interviews

Interviews for three different groups of participants were formed: kitchen retailers, consumers who recently replaced their kitchen (appliances) and consumers who have ATAG's Hood-in-Hob Elevate™ in use.
With three groups semi structured interviews were conducted. A predefined interview guide was used to cover all the topics, on top of that there was room for follow up questions. The questions were open questions, in order to stimulate the participants to elaborate on their answers. The full list of questions can be found in appendix B.
All interviews were conducted via the telephone, the conversations were recorded and transcribed using Word. The transcribed interviews were coded using Atlas.it software, using inductive coding. First quotes were coded individually, than similar codes were grouped and lastly the codes were categorised (appendix B).

Kitchen retailers

The main goal of the interviews with this group was to get insight into why consumers replaced their kitchen (appliances), the state of replaced appliances and what happens with the appliances at the end of life.
Three kitchen retailers located in Delft, Breda and Winterswijk participated. All retailers sell ATAG branded products.

Consumers who replaced their kitchen (appliances)

The goal with this interview group was to get insight into the reason of replacement, what happened with the product at the end of life, the perceived remaining value of the product at and of life and the attitude towards refurbished products.
Participants were approached via acquaintances, a total of 15 people participated. Al participants are home owners living in different parts of the Netherlands, ranging from Haarlem to Aalten. Living in apartments, newly built homes and historic farms. The ages of the participants ranged from 31 to 76. 10 of the 15 participants replaced their entire kitchen, 5 participants only replaced their hob.

Users of the Hood-in-Hob Elevate™

The goal with this interview group was to get insights into the product care the user performs.
Participants are employees of ATAG who participate in field testing the product, since the HIH is not yet available on the market. Six field testers participated with in the interviews. Hobs with integrated hoods from other brands were not considered. The ATAG HIH that is used as a case study has an tower that can be elevated to bring the inlet to the hood closer to the pan and has temperature-controlled cooking. This combination of additional functions cannot be found in other brands and both functions could cause different product care behaviour.

3.2 Results

3.2.1 Product care

Product care encompasses all activities that could positively influence the product lifetime (Ackermann et al., 2021). It includes preventive care measurements and performing maintenance. According to Magnier & Mugge (2022) product care can prevent product failure.

The only product care activities mentioned in the interviews were the cleaning of the glass plate and the grease filters of the hood. Different cleaning methods and time intervals were mentioned. Though most interviewees mentioned they cleaned when the product was visibly dirty. Which is easier to see with the integrated hood than a regular hood, because you look inside the hood.

The product does not require any maintenance, there are no filters that need replacing etc. The glass plate and the tower cannot be made to last longer through preventive maintenance: damage to these parts are usually the result of user errors (ATAG QA, personal communication, January 2023).

3.2.2 Product repair

Of the interviewees only one had a damaged hob, this is the only one who could provide insights into the decision of making a repair or not. As a result this paragraph is based on literature and what participants owning a HIH say they would do in case of product failure.

According to Magnier & Mugge (2022) a product has a higher probability of getting repaired when under warranty. This is in line with the interviews, in which all the HIH user said they would call for service within warranty.

Barriers to repair

After warranty consumers find it more difficult to decide whether they should repair or not. Cox et al. (2013) mention that consumers find it difficult to estimate whether the repair will be worthwhile. They do not know how long the lifetime of a product will be extended by a repair and whether that is worth the time, effort and money. Something similar was mentioned by interviewees, 'a new product is twice the price of a repair'. In this case they preferred replacing the product over repairing it. This also illustrates that the decision to repair are not based on environmental considerations, but on financial benefits (Cox et al.,2013). Lastly products are repaired more often when they are completely broken, than when they are only partly broken/malfunctioning (Magnier & Mugge, 2022). The only participant of the interview with a broken hob had a cracked glass plate, but the product still functioned. The participant did not perform a product repair, but ignored it and replaced the product after a while together with the rest of the kitchen.

Motivators to repair

Ackermann et al. (2018) identifies the following factors that influence the users ability to perform a self-repair: perceived knowledge and skills, time and effort, tools and general repairability. At the moment the HIH does not meet any of these factors. None of the HIH users perceive their own knowledge or skills being sufficient to attempt a repair. And based on the outcomes from chapter 2, the HIH does not meet the factors of time and effort, tools and general repairability either at the moment.

In the same research Ackermann et al. (2018) present motivators to perform a repair. A relevant motivator for the HIH is functionality: a product with high functionality which is used regularly has a bigger chance of being repaired, the HIH is such a product.

Pozo Arcos et al.'s (2020) research into diagnoses of a defective product shows that the use of error codes to identify the problem, contributes to the consumers perceived ability of performing a repair. The HIH has error codes, which point clearly to one or two parts which could be responsible for the failure. Pozo Arcos et al. (2020) also states that good visual and manual access contributes to the perceived ability to perform a repair.

Price

Magnier & Mugge (2022) states that if the consumer is going to perform repairs, by themselves or by professionals, repairs should be made cheaper, more accessible and more socially desirable than buying a new product. This is also mentioned in the interviews. About half of the participants said that it was easier and cheaper to replace the product than to repair it after warranty or that for small additional costs they had a new product.

Ackermann et al. (2018) presents price as a motivator to perform repairs. A higher product price increases the chance of repairing the product, this same observation is made by Hennies & Stamminger (2016). While it can also be a barrier: a higher price of spare parts reduces the chance of the product being repaired. Repairs on the HIH are free (within warranty) or €99 (partial warranty), which is a cheap compared to the €4000,- new price of the HIH.

3.2.3 Product replacement

The reason for product replacement depends on different types of obsolescence. Based on the interviews and literature the relevant types of obsolescence are discussed. A difficulty with this is that most of the interview participants replaced their entire kitchen, so the reasoning and considerations are made for the entire kitchen and not exclusively for the hob.

Psychological obsolescence

Psychological obsolescence is the desire for trends, design and lifestyle, that makes products old fashioned (Hennies & Stamminger, 2016). This mainly occurs when users replace their entire kitchen.

> *"I no longer like the product"*
>
> (Hennies & Stamminger, 2016, p.76)

All the participants of the interview who replace their kitchen, did not consider keeping the kitchen appliances. In their opinion the appliances were not suited for their new kitchen, no matter they did not express failure of the product (technical obsolescence) or new wishes (functional obsolescence). Multiple participants even expressed that they had saved for a new kitchen, so they deserved to have new appliances.

One of the participants who owns a HIH said that the HIH would be replaced when the kitchen would be replaced. Even if nothing is wrong with the hob, the user will replace it. This illustrates that a product only gets the lifespan the user expects the product to have (Cox et al., 2013), (Hennies & Stamminger, 2016) and (Magnier & Mugge, 2022).

This could be explained by the consumer having the feeling that he has earned back the value of the old product, making it okay to replace it (Magnier & Mugge, 2022). In the same research "it was time for a new product" is identified as one of the most important reasons for product replacement.

Functional obsolescence

Functional obsolescence is the replacement because of the desire for new innovations, new features and new interfaces (Hennies & Stamminger, 2016)

> *"I was not satisfied with the features"*
>
> (Hennies & Stamminger, 2016, p.76)

> *"The resource efficiency of the appliance was not satisfying"*
>
> (Hennies & Stamminger, 2016, p.76)

Mainly the participants who did not replace their entire kitchen, but only the induction hob, gave reasons for replacement which fall under functional obsolescence. Namely because they were not content with the current functions of the old product "the fish pan did not fit on the old cooktop", or because they desired new functions "now we have one with an integrated hood and that looks much better".

Technical obsolescence

Technical obsolescence is when failure of the product is the reason for replacement (Hennies & Stamminger, 2016). Only one of the participants of the interviews replaced their hob because of technical obsolescence.

> *"The appliance was defect"*
>
> (Hennies & Stamminger, 2016, p.76)

Economic obsolescence

Economic obsolescence is justifying replacement because of financial factors. A few interview participants did so, they said that a new product was only twice the cost of the repair. Pronouncing it more logical to replace the product than having it repaired. Other participants who replaced their entire kitchen also stated that when they went to a kitchen retailer it was expected that they replaced their appliances. Which is also financially attractive to do, because high discounts are given on appliances in combination with a new kitchen.

3.2.4 Acceptance of refurbished products

Barriers

Mugge et al. (2017) present in their research 8 types of product categories. Based on the literature and interviews the HIH would fit in three of these categories: hygienic products, utilitarian products and high involvement products.

Hygienic products are products like an electric toothbrush and microwave. In this case the product comes into contact with food, giving the feeling to the consumer that it is contaminated. Design strategies to deal with this are: enhance ease of cleaning and communicate the effort of cleaning and disinfection done during the refurbishment process. However, this category is relevant purely based on literature, only one interview participant mentioned hygiene as a barrier to buying a refurbished hob.

The most mentioned barrier by the interviewees was a perceived shorter lifetime than a new product. Perceived shorter lifetime applies to an utilitarian product like a suitcase or drill. For this kind of products, it is most important to reassuring the consumer of the product durability and long use. Design strategies for this are: design for upgradability, adaptability and ease of repair.

The second most mentioned barrier was that interviewees justified buying a new instead of a refurbished product, because it is such a large investment. This has the most in common with high involvement products like laptops and smartphone. The HIH is seen as a big financial investment, the consumer uses that to justify for themselves that they deserve a new product. To overcome this the consumer needs to be convinced that the refurbished product is worth the money. Design techniques for this are: warranty, certified product quality control and transparency of refurbishment process.

Motivators

In the interviews a few motivators for accepting a refurbished product were mentioned. The most mentioned motivator was the price difference. Though some participants also mentioned that the price difference should be big enough in order for the risk to be worthwhile. Participants also mentioned that is was better for the environment.

3.3 Conclusion

To what extent does the user perform product care?

Currently the only product care needed is the cleaning of the HIH and repair within warranty executed by ATAG. The HIH is not fit for consumers to perform repairs themselves and it does not require other types of maintenance than cleaning.

What is the main reason for product replacement?

The main reasons for product replacement during the kitchen lifetime is functional obsolescence. The main reason for replacement together with the rest of the kitchen is psychological obsolescence.

What is the attitude of the user towards refurbished product?

There is not one answer to this question, the main barriers based on literature and interviews are hygiene of the product, perceived shorter lifetime of the product and perceiving a refurbished product as less valuable. The main motivators on the other hand were the product being cheaper and the wish of the consumer to be better for the environment.

Design take aways

- The extended lifetime a repair provides must be clear to the consumer.
- Performing a repair must financially be more beneficial than replacing the product.
- Irreversible connections must be avoided.
- For dis- and reassembly a minimal amount of tools must be needed.
- There must be no wrong way to perform a dis- and reassembly.
- Defects must be easy to diagnose, pointing to only one or two possibles causes.
- The design must have good visual and manual access when dis- and reassembled.
- The product must be easy to clean.

4. Product journey map

4.1 Current product journey map

Based on the chapter 2 and 3 a product journey map (Van Boeijen et al., 2020) was created. It represents the current linear lifecycle of the HIH.

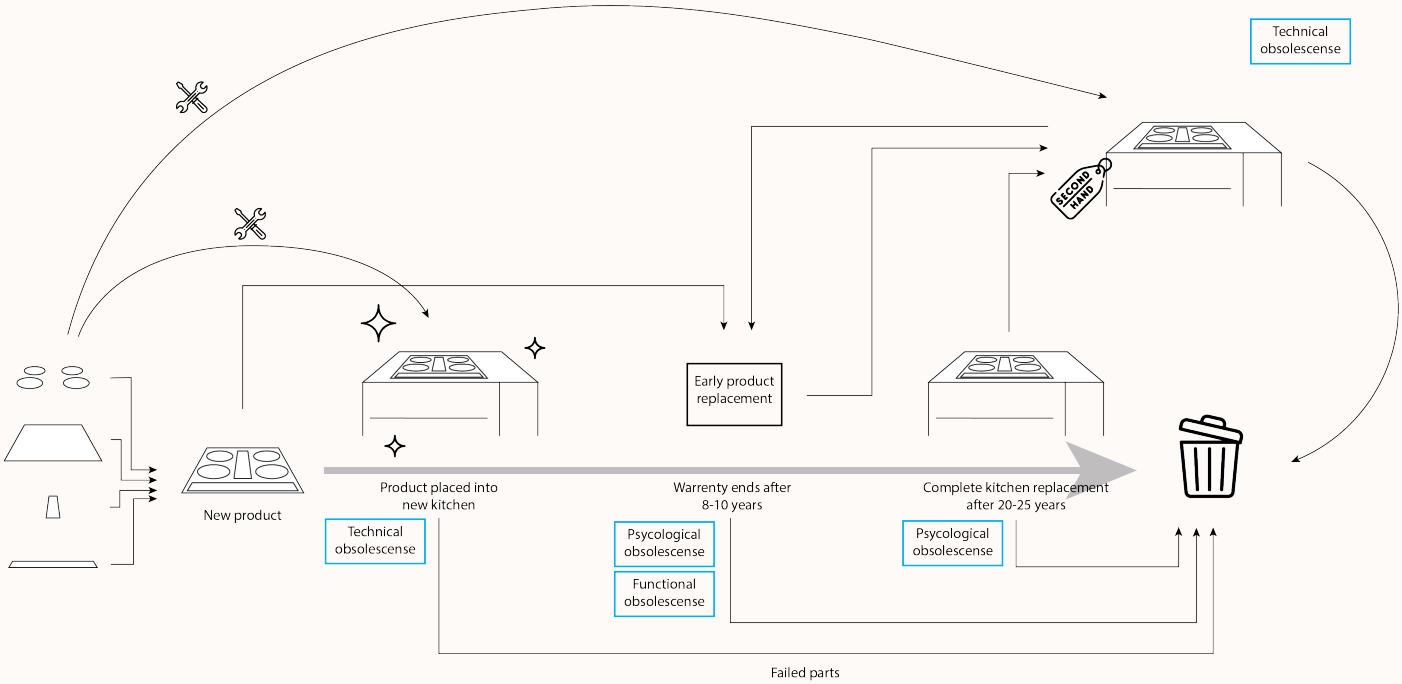


Figure 11: Current product journey map

A new HIH is placed into a new kitchen, as long as the HIH is under warranty ATAG services the product for free. The expected end of life of the HIH is after 10 to 14 years, at this point the HIH is replaced for a new one. Depending on the consumer the HIH is recycled or goes to the second-hand market. After another 10 to 14 years the whole kitchen gets replaced, including the new HIH. Which again is recycled or goes to the second-hand market, depending on the consumer. Owners of second-hand products can still contact ATAG for repair requests, only they will need to pay for the repair. When a product in the second-hand market breaks down it eventually will be recycled.

4.2 Desired product journey map

The goal is to extend the product lifetime, preventing early product replacement and ultimately also preventing the product replacement together with the kitchen.

This means mainly overcoming psychological and functional obsolescence, this is done by designing for upgradability and remanufacturing (van Nes & Cramer, 2005). If the lifetime is extended the chance of technical obsolescence also increases, therefore design for repair should also be included.

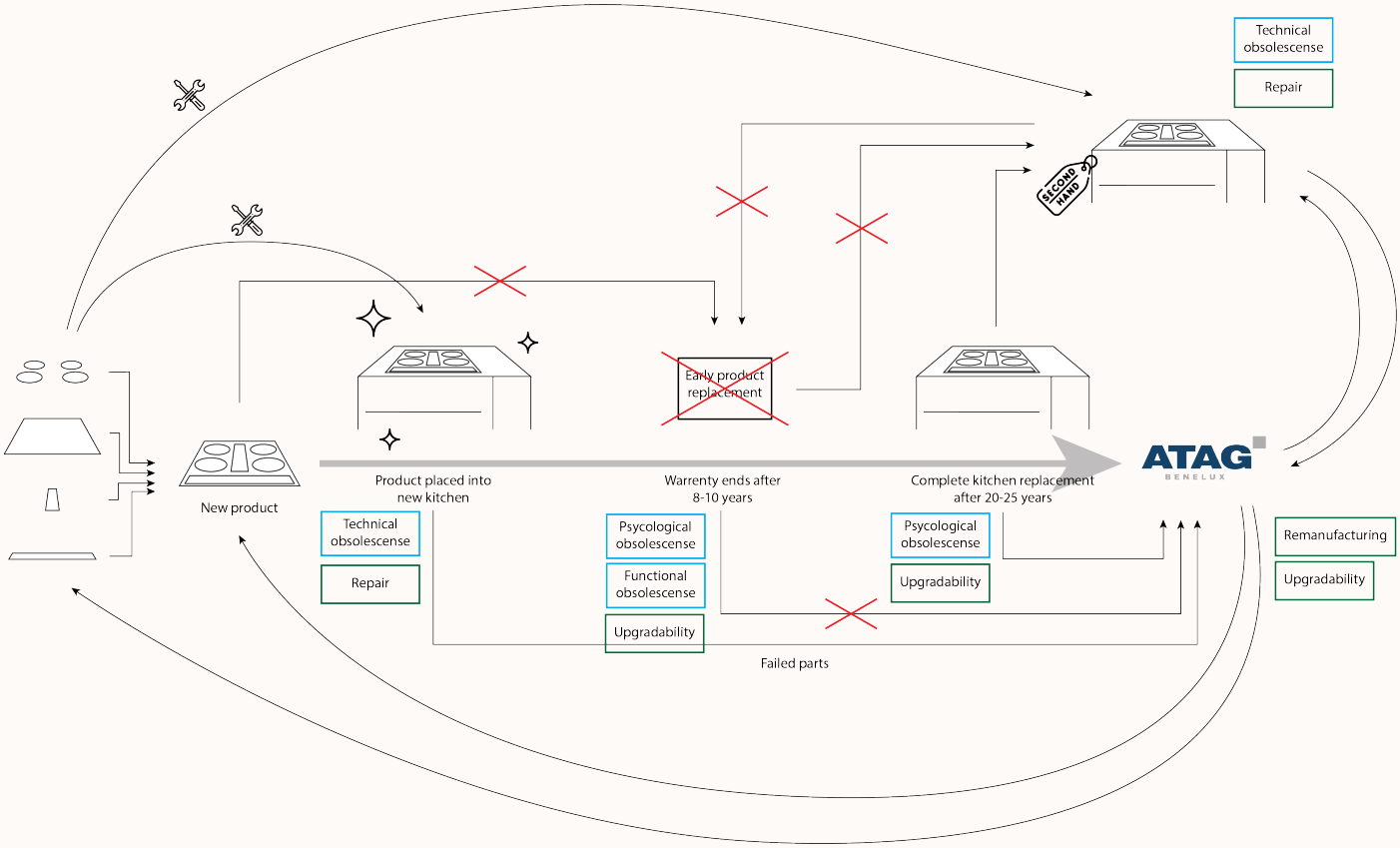


Figure 12: Desired product journey map

4.3 Future vision

The most inner circles of the rainbow diagram are about keeping the product in use for as long as possible. In order to do so, some attention must go to possible changes in the future. To make this more tangible the aim will be set to make the HIH relevant for the next 50 years. One way for this, as mentioned in 4.2, is to make the design fit for upgradability. Below the most likely future upgrades are listed (ATAG, personal communication, March 2023):

Glassless design

It is expected that in the future the induction coils are connected directly under the countertop. In order to realize this the countertop needs to be protected from the high temperatures of the pans. This can be done by placing a protective rubber ring under the pans, or make double-walled pans. Another option for this is temperature-controlled cooking, eliminating the risk of making the pans too hot. This makes this update extra relevant for the HIH in the future.

User interface

In terms of the user interface, it is expected that development will continue to more smart interaction. For example voice control, automatic control based on a recipe or personalised cooking configurations depending on which phone is connected.

On top of that the user interface has a big impact on how up-to-date a product is perceived. With only upgrading the user interface, the whole product could be perceived as more valuable.

Wireless power

Lastly, wireless power is something that is developing fast and which in the future might also be integrated into an induction hob. This could for example be used to power an air fryer which can be placed right next to the hood.

5. Design vision

The goal of this graduation project is to show how kitchen appliances can be made fit for the circular economy, using the HIH as a showcase. In order to continue to the ideation phase this goal needs to be more specific.

To design an induction hob that supports a transition from a linear to a circular economy. Showing that with small changes in the design, it can be made easy to disassemble and thus fit for repair and remanufacturing.

5.1 Program of requirements

Requirements based on chapter 2:

The priority parts must be within easy research: a maximum of 4 simple steps.

All parts must be replaceable without removing the glass plate from the countertop.

The replacement of part 'just in case' must be avoided.

The time of the service engineer must be used efficiently, preferably on performing repairs and not on travel.

The replacement of any part must be performable within 30 minutes.

Requirements based on chapter 3:

The extended lifetime that a repair provides must be clear to the consumer.

Performing a repair must financially be more beneficial than replacing the product.

Irreversible connections must be avoided.

For dis- and reassembly a minimal amount of tools must be needed.

There must be no wrong way to perform a dis- and reassembly.

Defects must be easy to diagnose, pointing to only one or two possibles causes.

The design must have good visual and manual access when dis- and reassembled.

The product must be easy to clean.

6. Ideation

Multiple ideation tools were used to generate a number of ideas. Individual Brainstorming (Van Boeijen et al., 2020) and 'How-Tos' (Van Boeijen et al., 2020) were used, the same tools were used in two creative sessions. The generated ideas were clustered and organized in a Morphological Chart (Van Boeijen et al., 2020). Using the morphological chart ideas have been formed.

6.1 Creative session

A creative session was organized to generate a high number of ideas, using experience from different people. The generated ideas were used as input for further brainstorming.

Pilot

As preparation for the creative session a pilot was done. The pilot was to check how much information should be provided and how much guidance was needed during the brainstorm. The pilot was performed with an IPD student and a graduated architecture student both from TU Delft. After the pilot it was decided to provide more guidance in the form of preforming 'How-To' questions.

Participants

4 colleagues of ATAG from the departments of: Innovation, Design and Product Management and ten HAN students joined from the studies Industrial Product Design, Mechanical Engineering, Technology, Policy and Management and Circular Economy. The participants were divided into three groups, all groups were a mix of colleagues and students from different studies.

Figure 13: Creative session

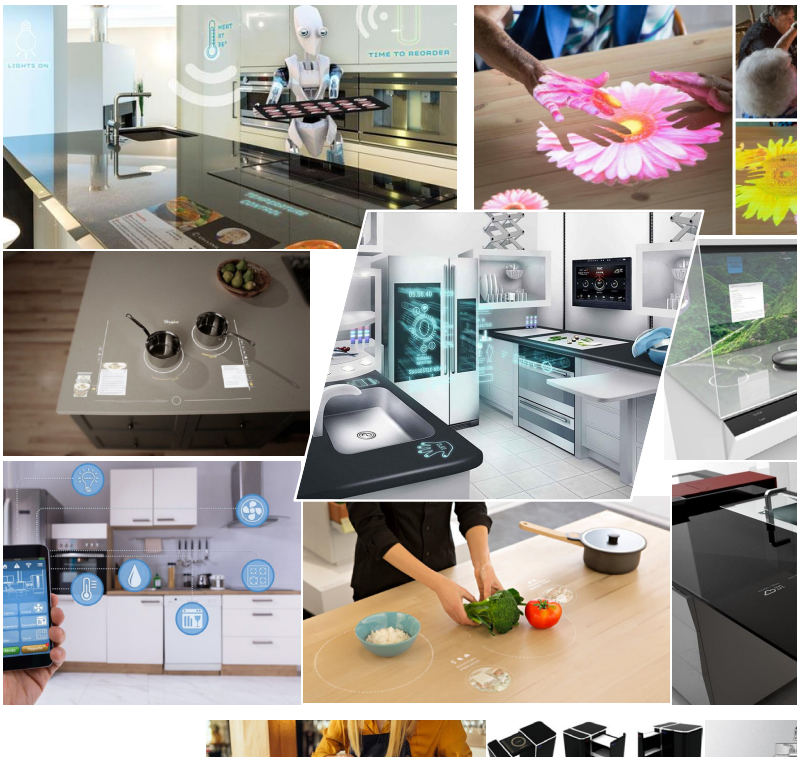
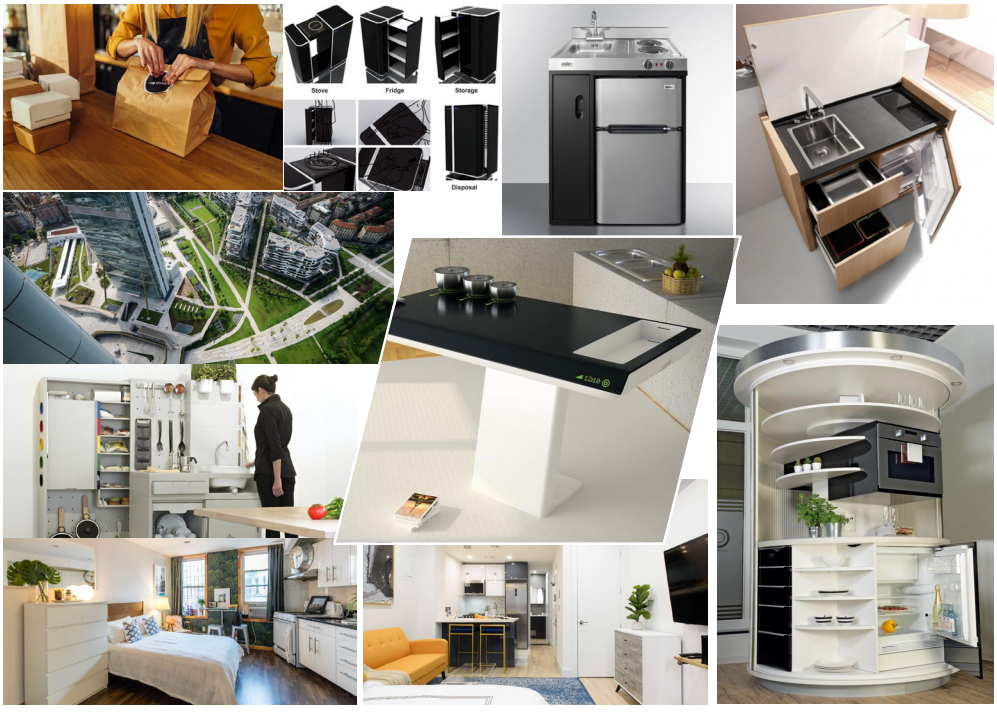


Figure 14: Mood board future visions:
a. Small change
b. Smart kitchen
c. Multifunctional kitchen



Introduction

The goal of the session was ‘how to make a cooktop fit for the next 50 years’. First a short presentation was given about the project so far, mostly focusing on the architecture of the product and the replacement behaviour of the customer. Next, 3 future visions were presented: small changes, smart kitchen and multifunctional kitchen (figure 14). Each group got one future vision to use as a source of inspiration for their ideation. The groups were given 10 minutes to discuss what they imagined a kitchen will look like in 50 years, based on their future vision. Next to a future vision mood board, each group was given a sheet with kitchens and hobs from the last 70 years (figure 15), as an illustrator to how products can change over time.

Brainstorm

The brainstorm started with an ice breaker, to stimulate hitch hiking on each other’s ideas. The brainstorm was structured by using How-Tos. Some How-Tos were generated beforehand as suggestions for the groups. They were given 10 minutes to discuss which How-Tos were most relevant to them, choosing from the suggested How-Tos or forming them themselves.

All groups had 4 or 5 How-To questions, the same number as participants in the group. Each participants had a sheet with one question for 3 minutes, coming up with as many options to the question as possible. After 3 minutes the paper was given to the next person. The next person read what the person before them had come up with, they added their own options to that. This was repeated till everyone in the group had had each paper.

After the How-To brainstorm the participants were asked to discuss the options within their group. Clustering the most promising options into ideas. All the generated ideas can be found in appendix C.

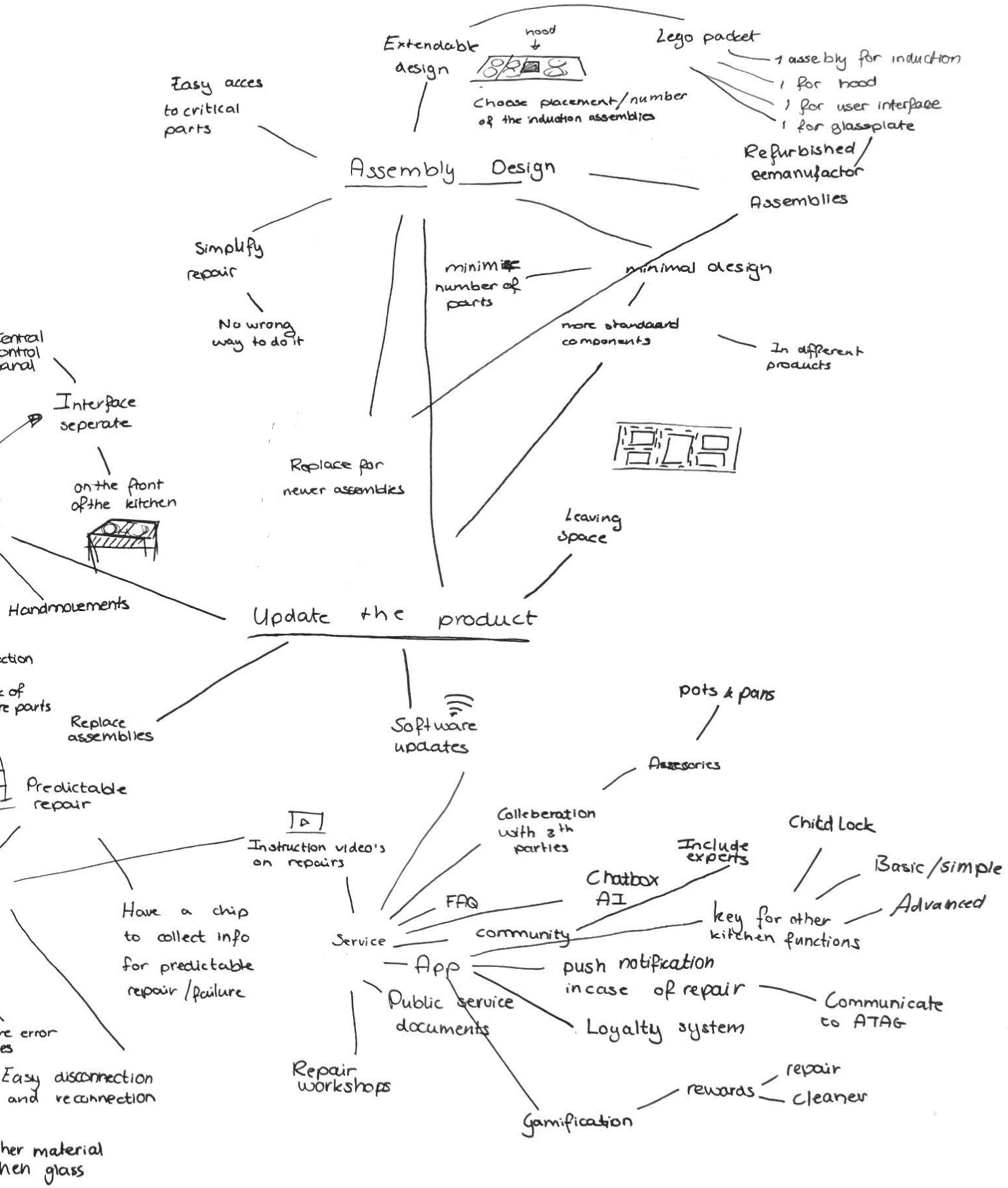
Figure 15: Kitchens of the last 70 years

6.2 Clustering into solution spaces

All the generated small ideas were collected and clustered into 4 main areas:

- Remanufacturing (future vision, possible future)
- User interface
- Upgradeability
- Repair

Figure 16: Clustered ideas


Assembly Design
Extendable design
hood
Choose placement/number of the induction assemblies
Lego packet
1 assebly for induction
1 for hood
1 for user interface
1 for glassplate
Easy acces to critical parts
Refurbished remanufactor Assemblies
Simplify repair
No wrong way to do it
minimise number of parts
minimal design
more standaard components
In different products
Interface seperate
on the front of the kitchen
Replace for newer assemblies
Leaving space
Update the product
Handmovements
Replace assemblies
Software updates
pots & pans
Assesories
Predictable repair
Instruction video's on repairs
Colleberation with 3th parties
Include experts
Chatbox AI
Child Lock
Basic/simple
Advanced
FAQ
Have a chip to collect info for predictable repair/failure
Service
community
key for other kitchen functions
App
push notification incase of repair
Communicate to ATAG
Public service documents
Loyalty system
Repair workshops
Easy disconnection and reconnection
Gamification
rewards
repair
cleaner

6.3 Morphological chart

All the generated small ideas were put into a morphological chart. After that concepts were created by combining small ideas going through the chart vertically.

Repair						
Diagnosing the problem	Error codes publicly available	Predictable repair				
Warrenty	Extended warrenty when performing maintance	Extended warrenty after reintallation done by ATAG				
Preventing repair	Case	Cover	Unbreakable material	Maintance kit		
Spare parts	Large stock	Public 3D printing files	Material passport	Temperatuur resistance	Public acces to parts	
DIY service community	Repair workshops	Public service documents	Gamificaition reward system, repair, cleaning	Loyalty system	Push notification in case of repair	
Service from the bottom	Glassplate separate	Rest of the product in a drawer	Click other parts of the product underneath	Glassless design	Form fitted	
Easy disconnection and reconnection	Screws	Snap fingers	Soluble glue	Form fitted	Loose	
Upgradability	Standardized parts	Simplify architecture	Easy acces to critical parts	Software updates	Leaving space for future upgrades	
Expandable design	Independent induction assembly	Independent hood assembly	Independent user interface assembly	Independent glasstop assembly		
Replace assemblies	Refurbish/ remanufactur assemblies	Replace for newer assemblies	No wrong way to exchange assemblies	Assemblies repairable with expertise	More energy efficient components	
Remanufactoring Future vision, future possibilities						
Multipurpose	Scales integrated	Air flitering (airfrier, onion cutting)	Cutting board	Hole HIH function as bin	Cookbook, grossery shopping	
Wireless power	Kettle	Airfrier	Toaster			
Glassless design	Direct under countertop	Under table	Integraded into a drawer			
User interface	Hand movements	Projection	Touchscreen	Voice control	Smart control (via a recipe)	
Separate interface	On the front of the kitchen	Central kitchen control panal	Via phone			

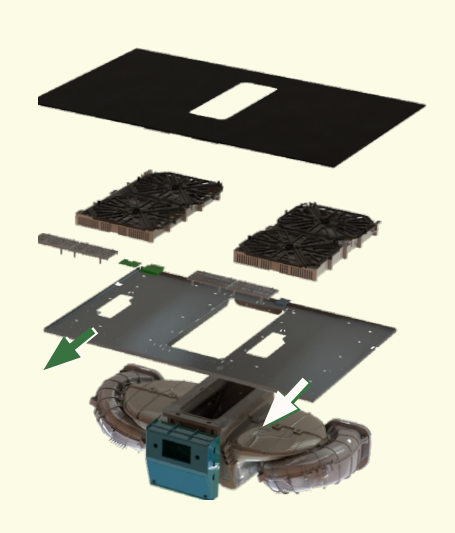
Table 4: Morphological chart

	Key for different kitchen functions per user	Experts provide knowledge	FAQ/Chatbot/AI	Colleb 3th parties (accessories, pans)	Instruction video's on repair	
	Magnets	Other materials than glass				
	Magnets	Press stud	Velcro	Slide connection	Zipper	Minimalize tools
	Minimalize number of parts					
	Hoob integrated into the wall					
	Stimulate sustainable behaviour	Visual on wall	Visual on countertop	Interface folding out	Interface sliding out	

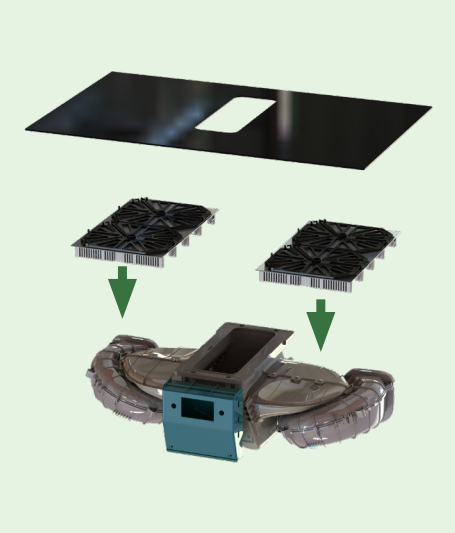
6.4 Concept Directions

Using the morphological chart and keeping in mind the design vision, the program of requirements and the upgradability options, three ideas have been created. Each idea consists of a change to the product architecture combined with a service system.

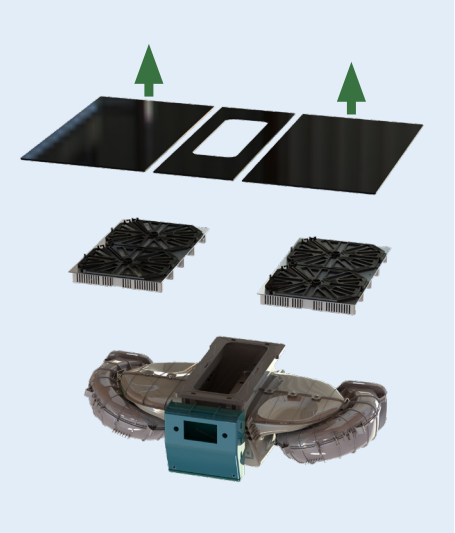
In terms of upgradability the ability to make the product glassless, upgrade the user interface and upgrade to wireless power should be taken into account.
For the disassembly most can be gained by making the induction components and the user interface better accessible. These priority parts are the ones not meeting the program of requirements at the moment.



Idea 1
Drawer



Idea 2
Separate user interface



Idea 3
Separate products

Idea 1 - Drawer

The first idea has very little changes compared to the current product. In this idea the glass plate is fixed in the countertop and the hood, the induction and the user interface can be completely serviced without removing the glass. The hood, induction and user interface are all still connected to one big aluminium plate, which functions as a drawer. This makes it possible to slide the whole plate out from under the countertop to reach the priority parts. This makes it easier to perform a disassembly, the priority parts can be reached faster and the visual and manual access is better.

Service system

The service system accompanying this idea is based on ATAG still performing all the repairs and upgrades. It is accompanied with a reward system, to stimulate product care. For example, if the consumer cleans the product regularly, the consumer gets an extended warranty as a result. The current warranty period is based on the expected lifetime of the product, and a product that is well cared for has a longer expected lifetime.

On top of that ATAG can participate in the market of refurbished and second-hand product. They can check the product and provide a warranty on it. This makes it beneficial for consumers to buy second hand or refurbished products from ATAG.

Upgradability

Since the product can be serviced from the bottom, it is fit for a glassless design in the future. Also, the induction assemblies can be exchanged for ones with wireless power, as long as it fits in the same space. The upgrade the options for the user interface are limited. Again limited space is available and it is still placed under the glass, leaving less possibilities.

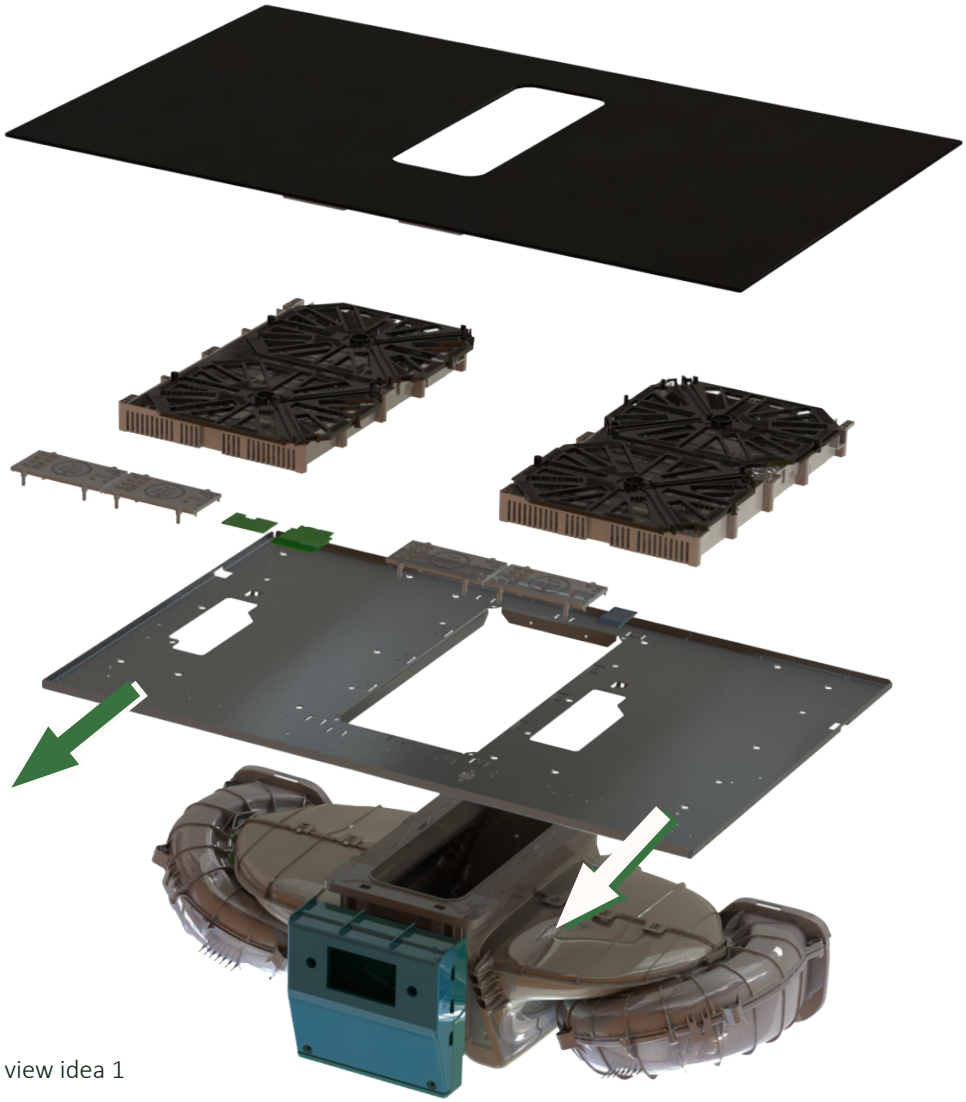


Figure 17: Exploded view idea 1

Idea 2 - Separate user interface

The second idea has more changes compared to the current product. The biggest difference is the user interface: the user interface is completely taken out of the product, making it a separate unit. This is to make it easier to upgrade the user interface, without changing the rest of the product.

On top of that, the architecture of the hood and induction is different. Instead of it all being connected to one big plate, it has three separate modules: the hood and two induction modules.

The hood is connected to strips glued to the glass plate. The two induction modules are also connected to strips glued to the glass plate. This makes it possible to remove the induction modules without removing the glass. The connection of the module to the glass plate is form fitted, so it can only be connected in one way.

Service system

In this idea the consumer can perform simple replacements themselves, after which ATAG performs the more complicated part of the repair. The separate modules enable the replacement of one module, without needing to open up the entire product. Consumers can replace a damaged module themselves, or replace it for an upgraded module. After which ATAG can perform the more complicated repair on the module, refurbish or recycle it.

This places more responsibility with the consumer. To support this, a community can be created, in which service documents can be shared as well as instruction video's on how to perform a diagnosis and/or replacement.

Upgradability

The architecture enables service from the bottom and upgradability to glassless design. Induction modules that can be removed separately, enable future upgrades to wireless power. Lastly, having the user interface completely separate leaves a lot of upgrade options for the future, without requiring changes to the rest of the product.

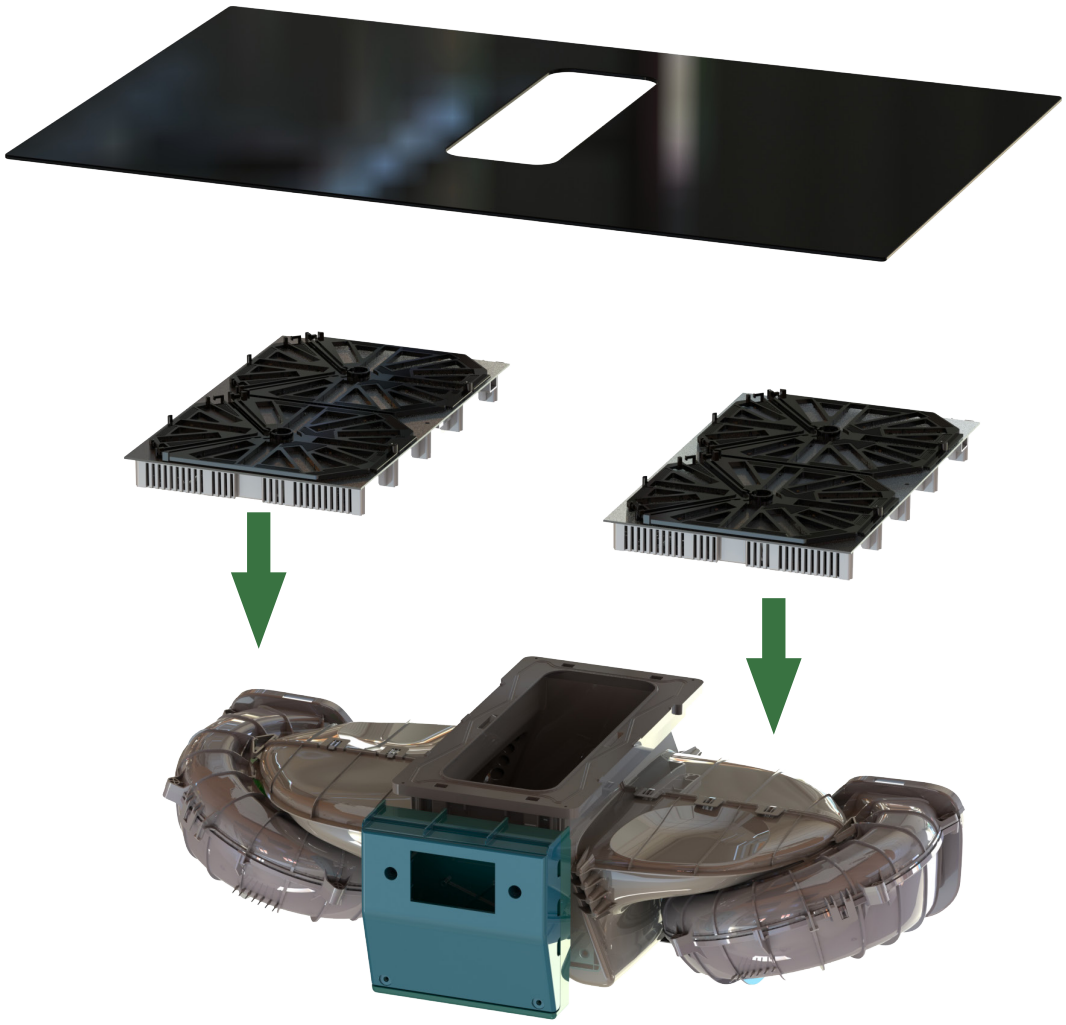


Figure 18: Exploded view idea 2

Idea 3 - Separate products

The third idea has the most changes compared to the current product. The idea is to make all the parts separate products, which can be placed next to each other in a way fitting the users wishes. This makes each product on its own simpler and makes the disassembly easier.

Because induction hob parts are simpler, smaller and easier to handle, it is less of a problem to remove the glass plate from the counter top. Once it is removed from the counter top, the priority parts can be reached within a few steps. The hood is more difficult to remove from the countertop, because the induction hobs will need to be removed first. However, the priority parts of the hood can still be reached from the bottom.

Service system

The simplification of the architecture makes it easier for service engineers to perform repairs. Less steps need to be taken and the product is easier to handle, making it possible to perform repairs within the set time frame.

Upgradability

In order to upgrade the product, one of the parts can be replaced for a new one that has the same size. ATAG could collect these by giving a discount on the new part, when the old one is handed back in. The old ones can then be remanufactured.

This idea is not suitable for glassless design in the future, the induction hob needs to be taken out of the countertop to be serviced. It is possible to replace one of the induction hobs for one with wireless power integrated into it in the future. ATAG can than reuse parts of it for new products. The user interface is- like in idea 2 - separate, which makes it easy to upgrade in the future.

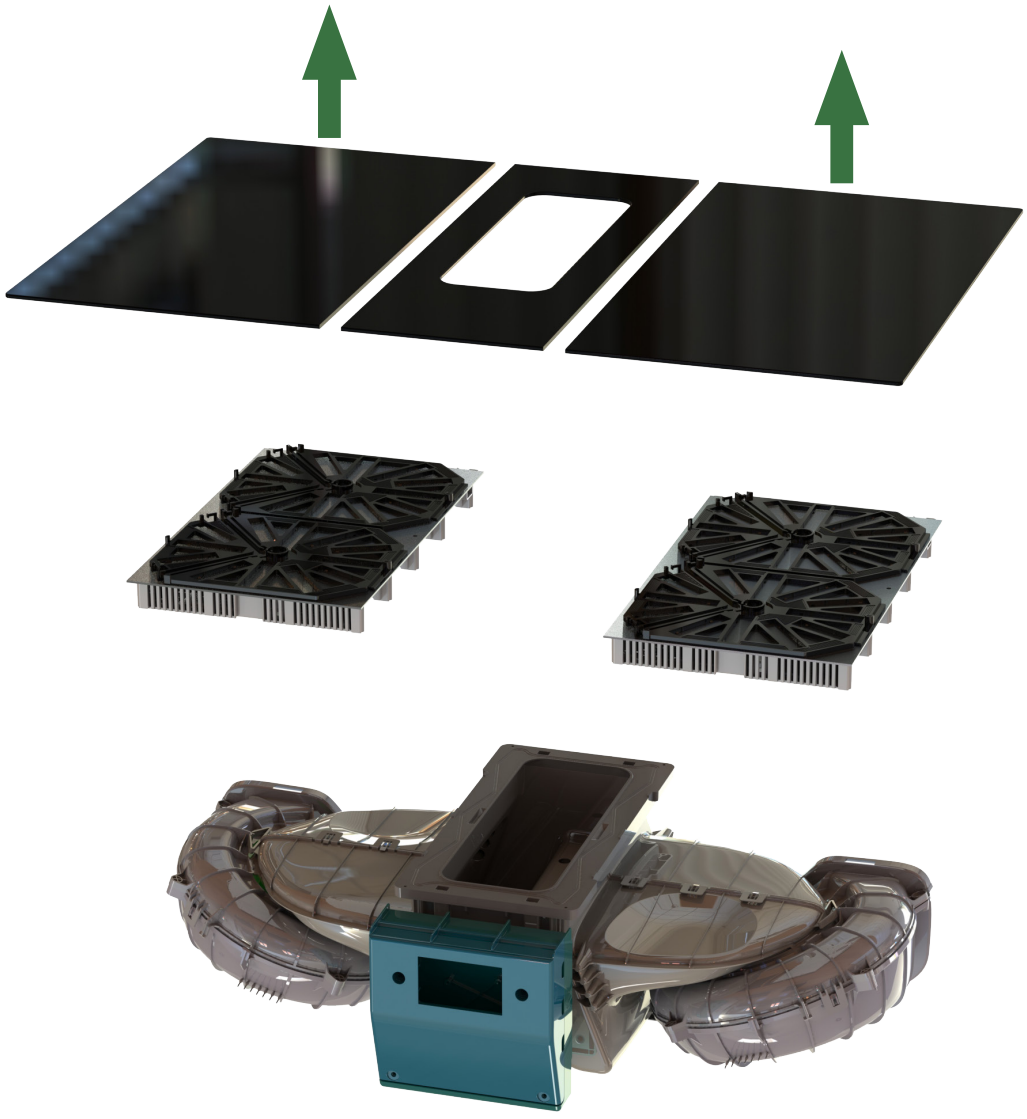


Figure 19: Exploded view idea 3

6.5 Selection

In order to decide which idea is most promising to detail it will be tested on a few things: to what extend does it fit the design vision, if it has potential to meet the program of requirements and the upgradability options it has.

Design vision

All three ideas can support a transition from a linear to a circular economy, the ideas differentiate the most on the second half of the design vision. Idea 1 is still very similar to the original product and easy to disassemble. However, it does not leave much opportunity for remanufacturing, all parts and tolerances are specific for this product.
Idea 2 is a small change to the current product, making it easy to disassemble and has less strict tolerances on new parts for remanufacturing than idea 1.
Like 1 and 2, idea 3 is easy to disassemble. It provides more options for remanufacturing, the spatial restrictions are less of a problem. But it is quite a major change from the current product.
In terms of the design vision idea 2 – separate user interface – fits the best.

Program of requirements

To what extend the idea fits the program of requirements is evaluated using a Harris profile (Van Boeijen et al., 2020). The requirements have been sorted from most important to least important. How well each requirement can be met, is based on both the possibilities that the architecture and the service system create. Of the three ideas, idea 2 – separate user interface – has the potential to meet most of the requirements.

Upgradability

All three ideas are fit to be upgraded for wireless power. Idea 1 is restricted in upgrade options of the user interface and idea 3 can in its current form cannot be upgraded to glassless design. Only idea 2 can be upgraded to glassless design, new user interface and wireless power.

Based on the design vision, program of requirements and the upgradability, idea 2 is the most promising to detail further.

Program of requirements

The priority parts must be within easy research: a maximum of 4 simple steps.

The design must have good visual and manual access when dis- and reassembled.

Defects must be easy to diagnose, pointing to only one or two possibles causes.

There must be no wrong way to perform a dis- and reassembly.

The replacement of any part must be performable within 30 minutes.

For dis- and reassembly a minimal amount of tools must be needed.

All parts must be replaceable without removing the glass plate from the countertop.

Irreversible connections must be avoided.

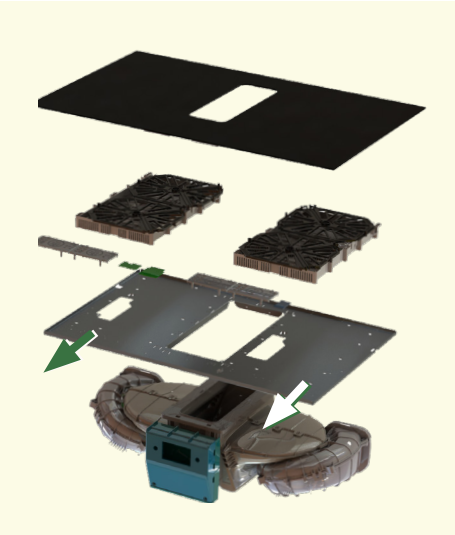
Performing a repair must financially be more beneficial than replacing the product.

The extended lifetime that a repair provides must be clear to the consumer.

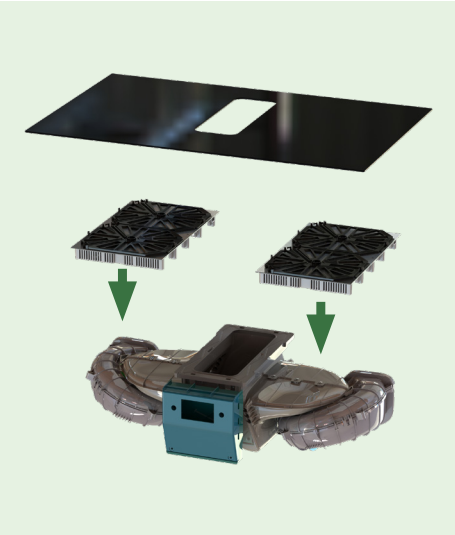
The time of the service engineer must be used efficiently, preferably on performing repairs and not on travel.

The replacement of a part ‘just in case’ must be avoided.

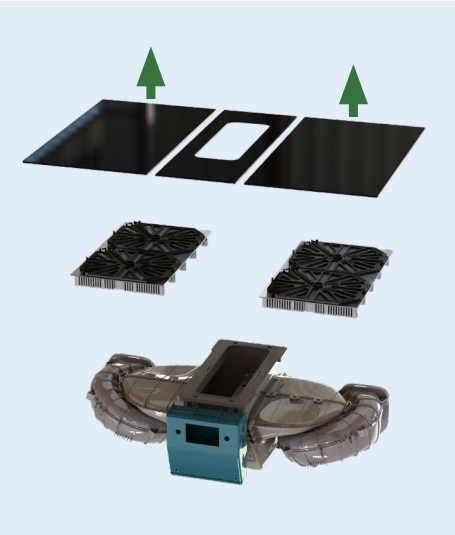
The product must be easy to clean.



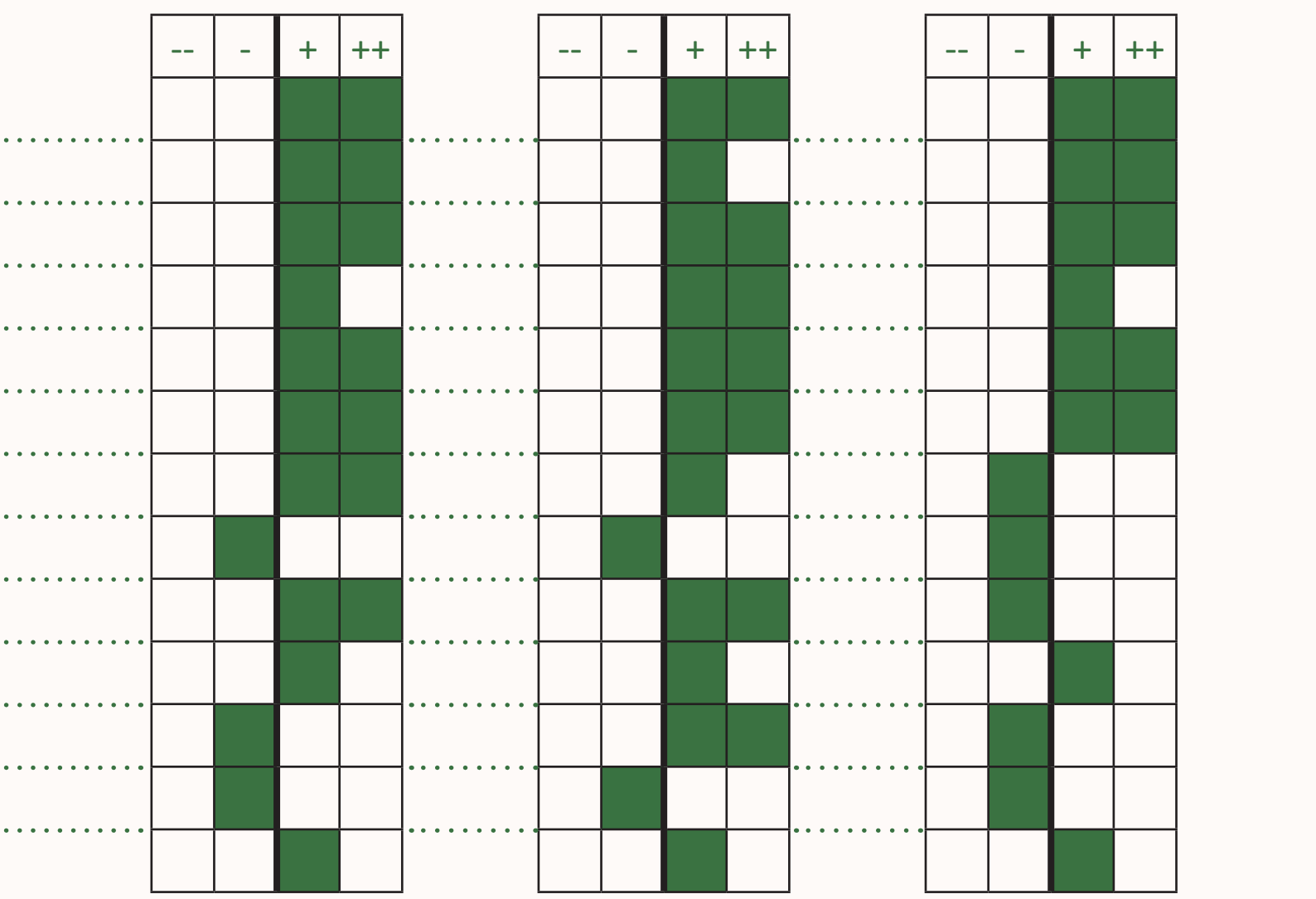
Idea 1
Drawer



Idea 2
Separate user interface



Idea 3
Separate products



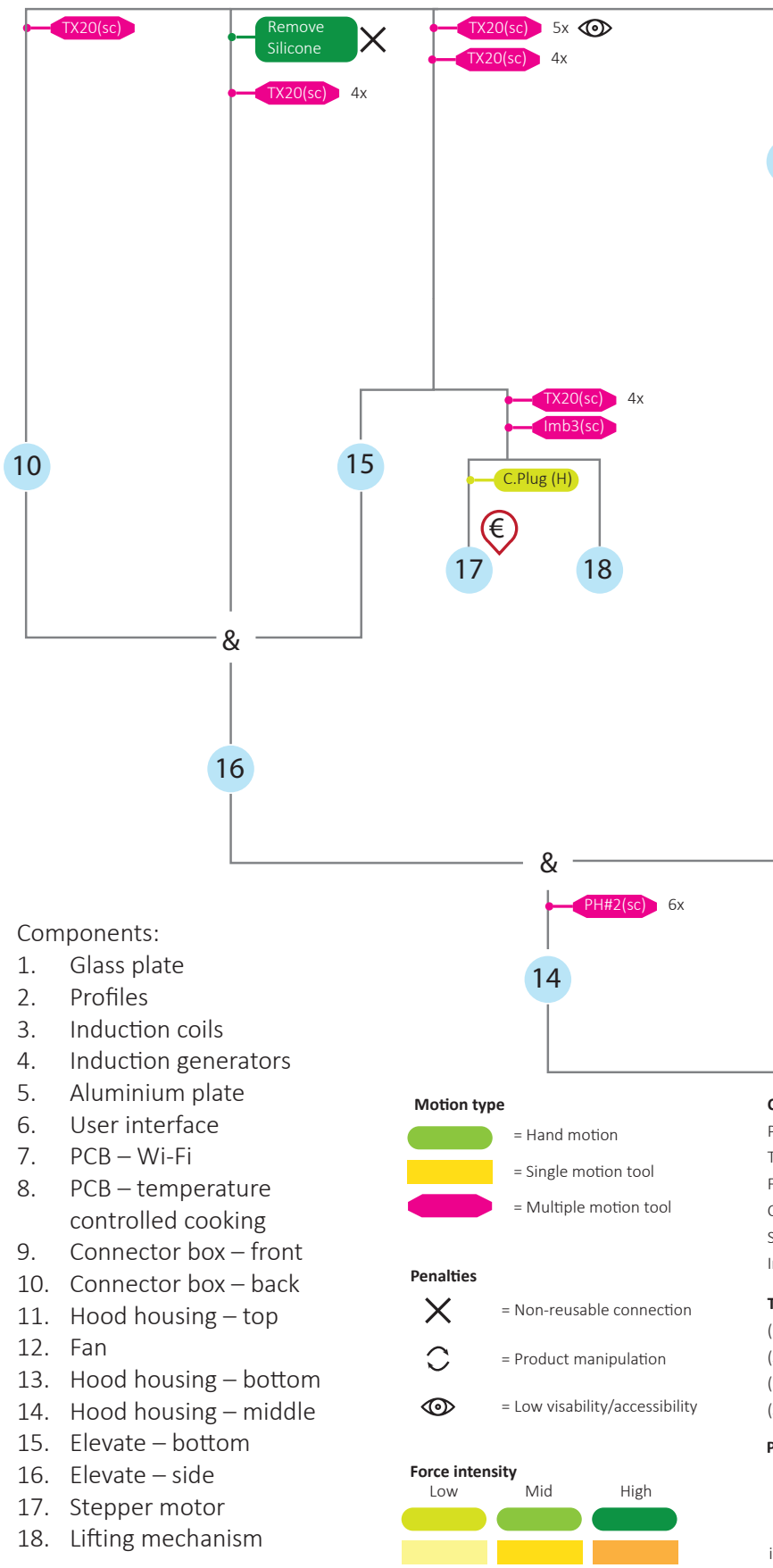
7. Concept

In this chapter the details of the chosen concept are presented: the product architecture, the accompanying service system and the concept's second lifetime. Lastly the new product journey map is presented.

7.1 Architecture

7.1.1 New disassembly map

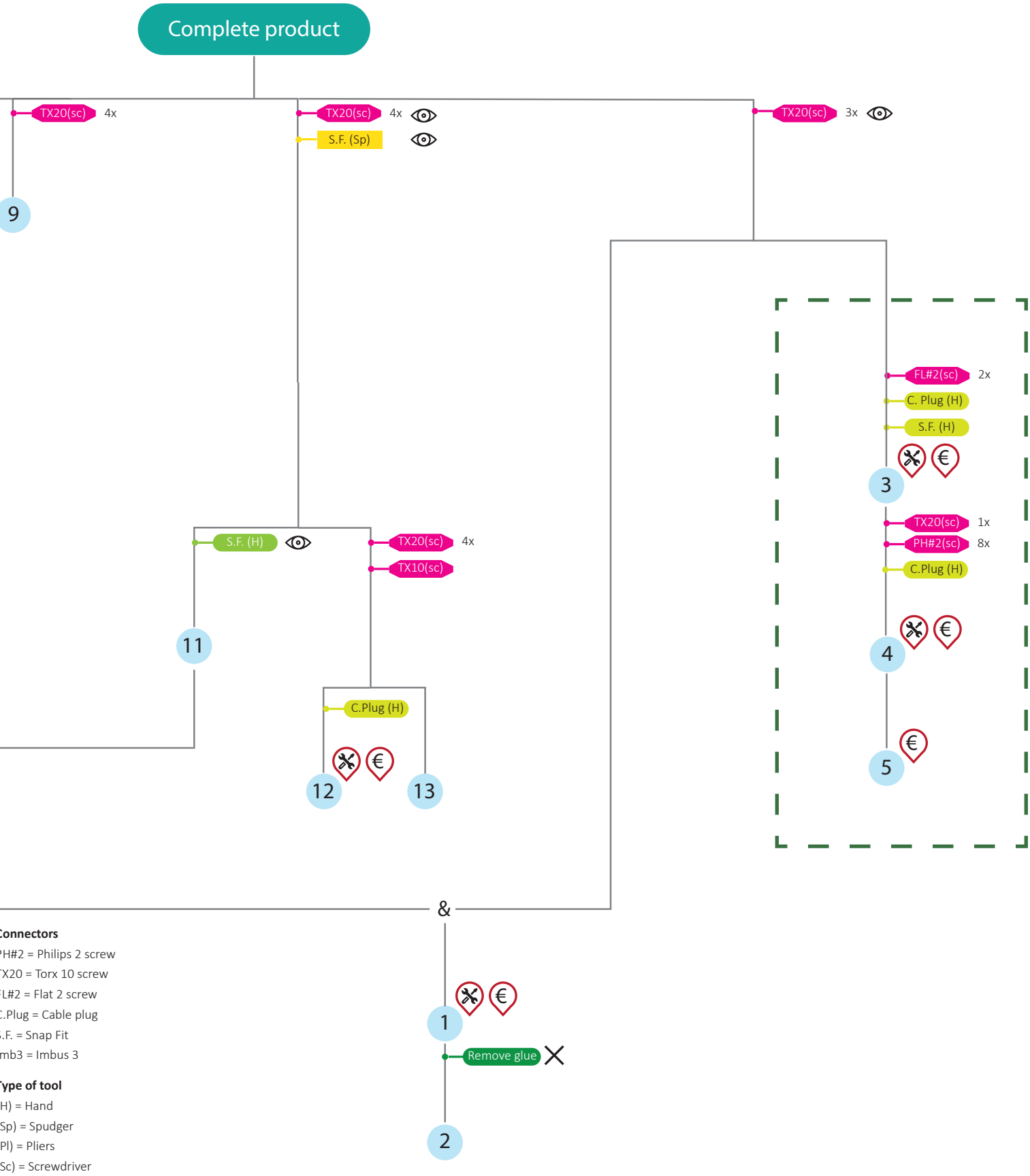
The biggest impact of the concept is in the architecture. By changing the architecture, the disassembly of the product is made easier. Figure 20 shows the new disassembly map, here it can be seen that part 3, 4 and 5 can be reached with 2 or 3 disassembly steps, whereas, before it required 12 or 13 steps. One of these steps was to take the glass plate out of the counter top. Removing the glass plate from the counter top is now only necessary to reach part 16, 14, 1 and 2. Of these parts only 1 is a priority part: the glass plate.



Components:

1. Glass plate
2. Profiles
3. Induction coils
4. Induction generators
5. Aluminium plate
6. User interface
7. PCB – Wi-Fi
8. PCB – temperature controlled cooking
9. Connector box – front
10. Connector box – back
11. Hood housing – top
12. Fan
13. Hood housing – bottom
14. Hood housing – middle
15. Elevate – bottom
16. Elevate – side
17. Stepper motor
18. Lifting mechanism

Figure 20: Disassembly map of the concept



Connectors

PH#2 = Philips 2 screw
TX20 = Torx 10 screw
FL#2 = Flat 2 screw
C.Plug = Cable plug
S.F. = Snap Fit
mb3 = Imbus 3

Type of tool

(H) = Hand
(Sp) = Spudger
(Pl) = Pliers
(Sc) = Screwdriver

Priority parts

Failure indicator
Environmental indicator
Economic indicator

7.1.2 Glass plate

The big change in disassembly is made possible by making the induction part into a separate module which can be removed without removing the glass plate from the counter top. Aluminium strips are glued to the bottom of the glass, to which the induction modules and the hood can be attached.

Connecting the induction module

After extra ideation (appendix D), a solution was chosen in which the back of the module is connected with a form fitting strip and the front of the modules is connected with screws.

On the back of the HIH a new strip is placed, with a C shaped bottom. In the aluminium profile a rubber strip is placed to absorb vibrations.

On the front a strip is placed into which screws can be attached, the same profile is used in the current HIH.

The aluminium plate of the induction module can be pushed in the C of the back strip and fastened with screws on the front profile. This way only the front strip needs to be accessible with tools. Also, in order to minimise the distance to the pans, the coils can be easily pushed up against the glass. This is achieved by first pushing the plate into the C and then tilting it slightly upwards.

Lastly, support strips are glued to the glass from front to back. These are used as an extra support for the stresses in the glass and are used as guides to make the placement of the induction assembly go more smoothly.

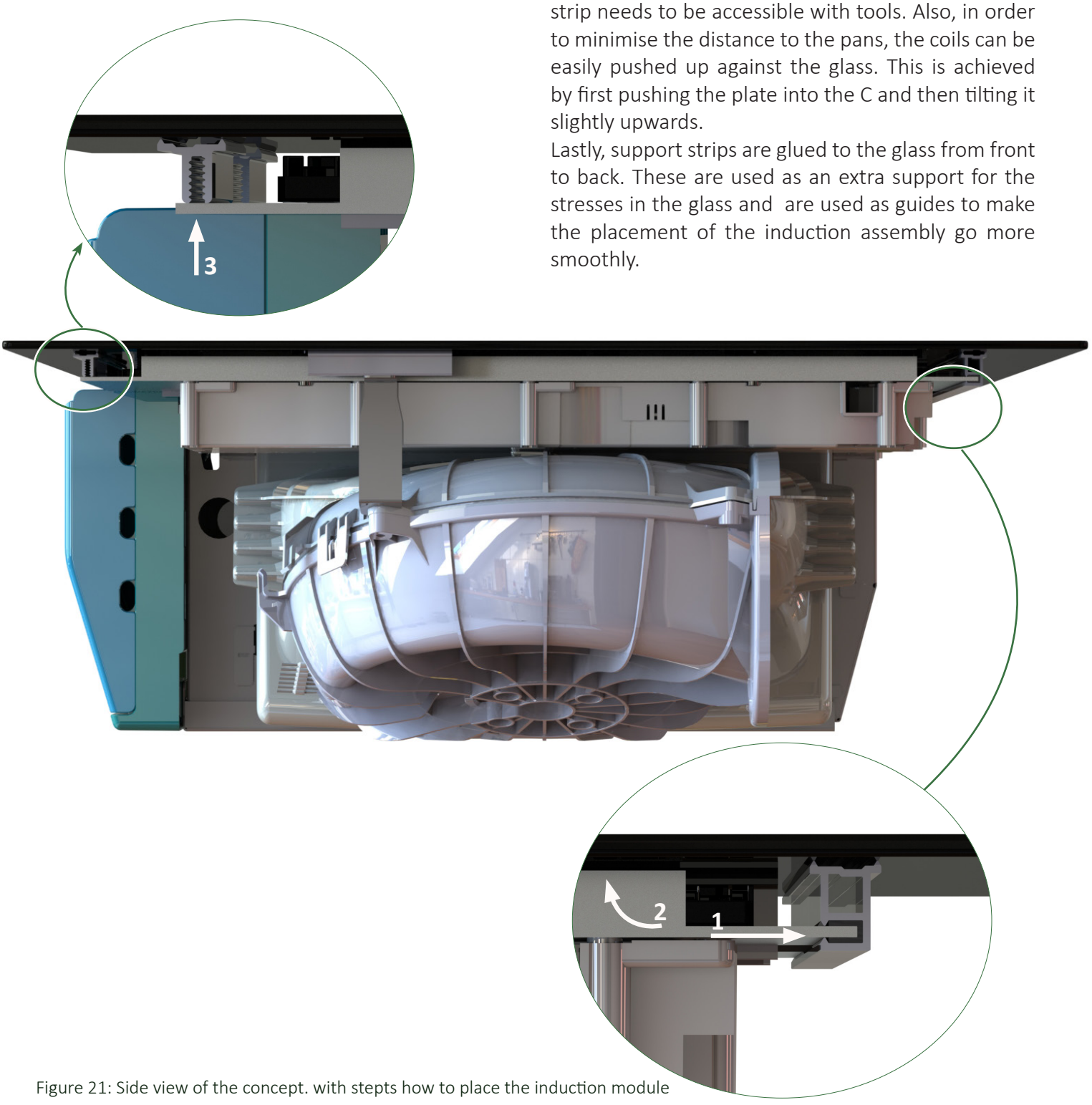


Figure 21: Side view of the concept. with stepts how to place the induction module

Stress and deformation of the glass

IIn the current HIH all parts are connected to a big aluminium plate, which contributes to the structure of the product. In the concept the big aluminium plate is left out. The structure must purely come from the glass plate and the strips glued to it. In order to verify this, it was simulated in SolidWorks.

As a load two pans with a diameter of 200 mm of each 10 kg have been simulated. In figure 23a and 24a the stress and deformation of the glass plate without strips can be seen. The combination of strips can be seen in figure 22.

The stress and deformation of the glass plate with the strips glued to it can be seen in figure 23b. The maximum amount of stress in the glass is $4,55*10^6$ N/m^2. The tensile strength of the glass is $6,25*10^7$ N/m^2, which is over 10 times higher than the maximal stress.

The maximum deformation was without strips 0,67 mm and with the strips 0,27 mm (figure 24b). The amount of deformation has been reduced by half. Also noticeable is the decrease of deformation on the edge of the cut out for the hood. Without strips this was the spot of the maximum deformation, with strips the deformation has been reduced to 0,20 mm at this spot.

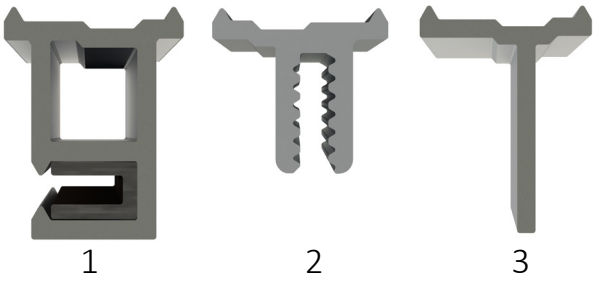
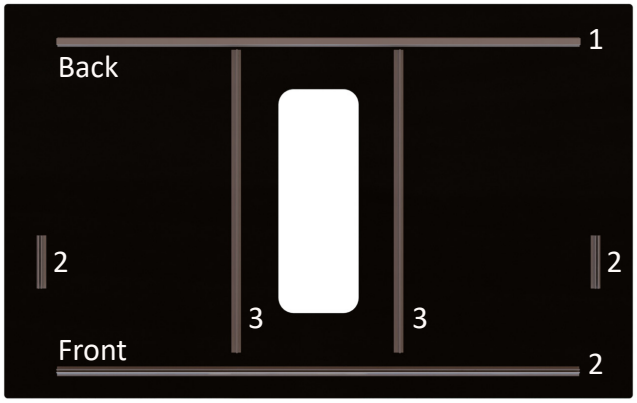


Figure 22: The used profiles and their placement



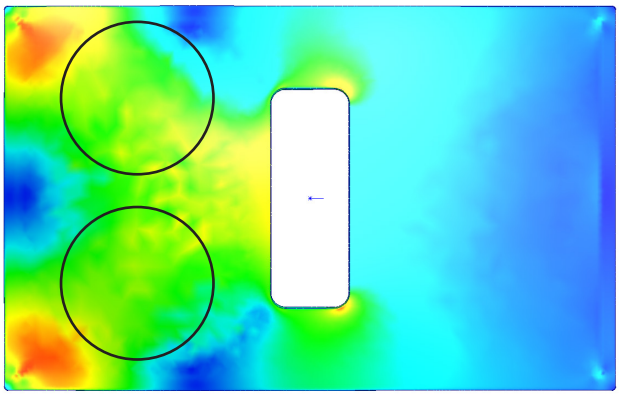


Figure 23a: Stress in the glass plate

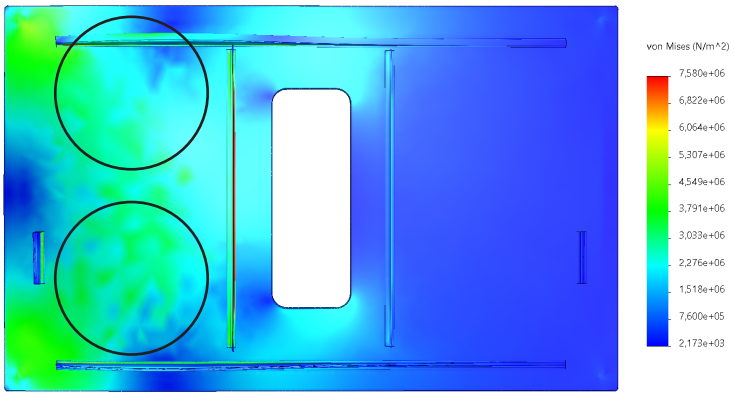


Figure 23b: Stress in the glass plate with strips

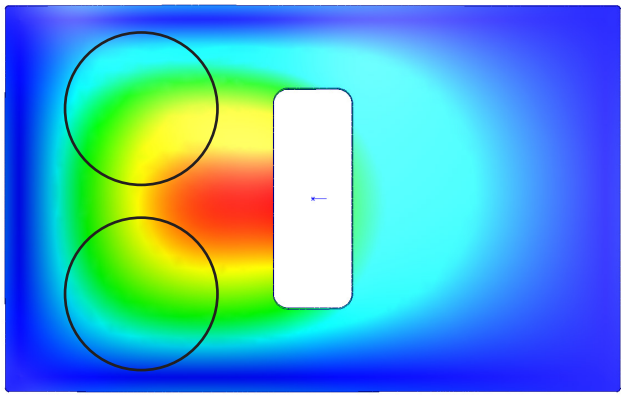


Figure 24a: Displacement of the glass plate

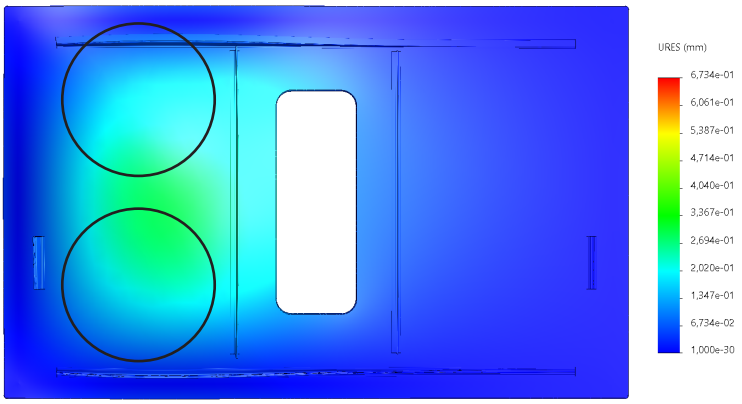


Figure 24b: Displacement of the glass plate with strips

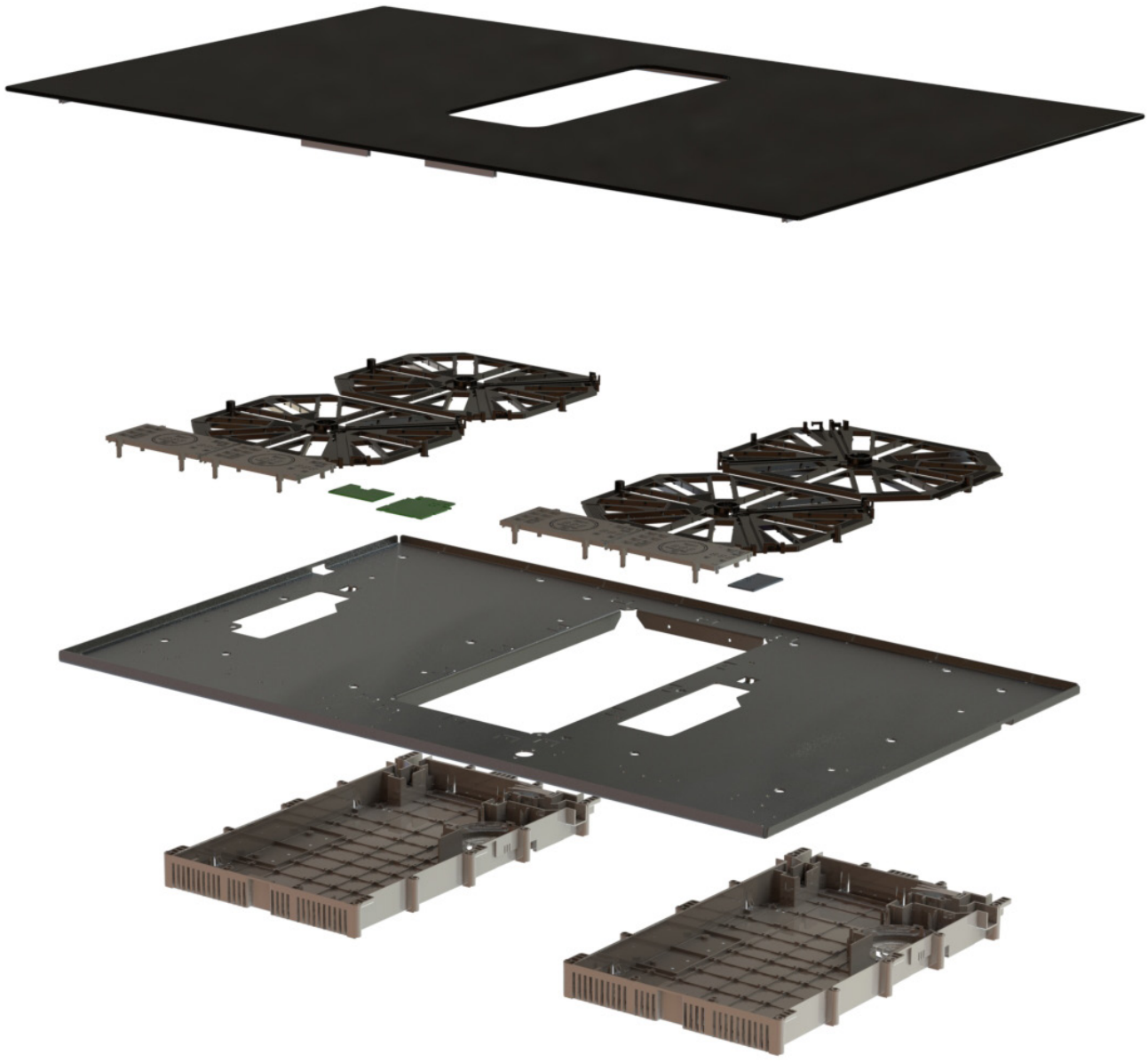


Figure 25: Exploded view glass plate, induction and user interface current Hood-in-Hob Elevate™

7.1.3 Induction module

The two separate induction modules replace the one big aluminium plate with the induction and user interface connected to it.

The induction module consists of: (1) the induction coil, (2) an aluminium plate and (3) the induction generator. The coil and the generator are both connected to the aluminium plate, making it one module. The aluminium plate is also how the module is connected to the HIH.
The long sides of the aluminium plate are folded in order to make it more rigid and prevent it from sagging.
The material of the plate is aluminium, because this material is not heated up by the magnetic field of the coil. On top of that it functions as an electromagnetic shield that protects the electronics of the generator.

In the current design of the HIH the cable is directly connected to the electronics of the generator. When replacing the induction generator, the cable needs to be disconnected in the connector box. Which means that the cable needs to be replaced together with the generator. In the new concept the induction generator has a plug. In this way, when disconnecting the induction assembly, it can be easily unplugged, without opening the connector box or replacing the cable.

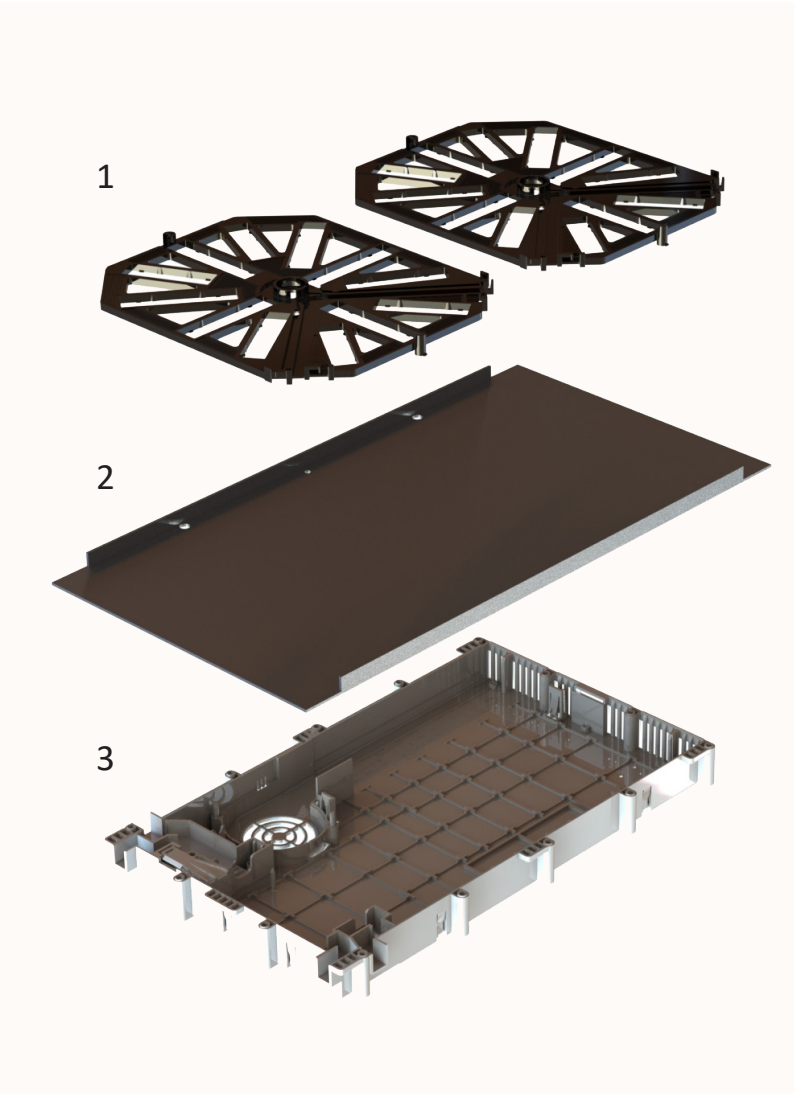


Figure 26: Exploded view induction module concept

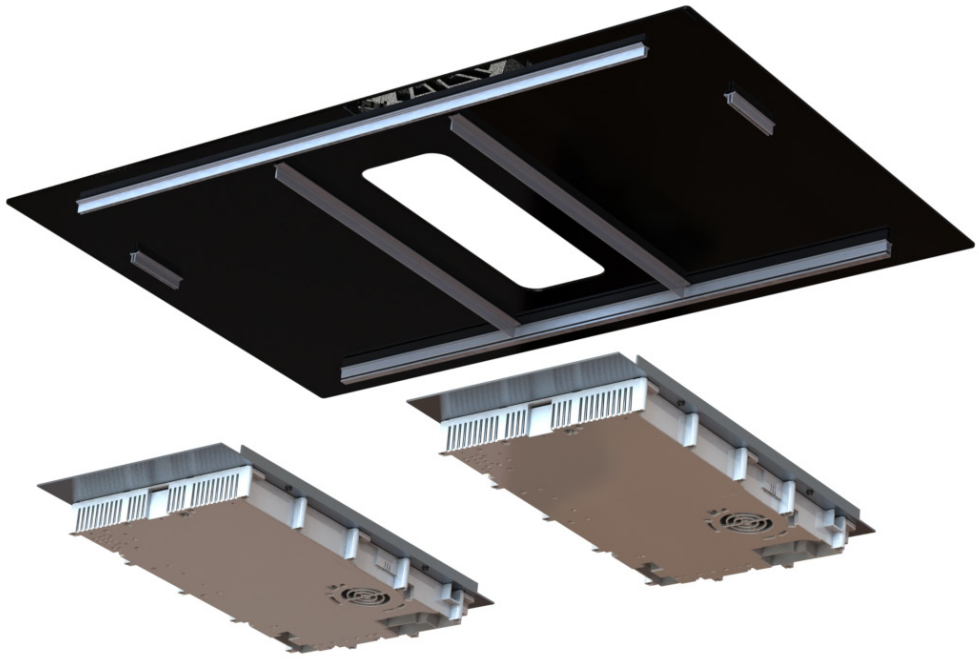


Figure 27: Exploded view glass plate and induction module concept

7.2 Upgradability

Glassless design

The concept is suitable for glassless design in the future. The strips can be connected directly to the countertop. Which allows for the hood and the induction module to be installed without the glass. Also, when the kitchen is replaced and in the new kitchen the choice is made for glassless design, the same product can be kept in use. The glass with the strips glued to it, needs to be replaced for strips which can be attached to the countertop. Allowing for the 'old' induction modules and the hood to be kept in use.

User interface

The next expected future upgrade is the user interface, because of the development into smarter user interfaces and because the user interface can make a product feel old. The user interface of the concept is completely separate, allowing for it to be replaced without any changes to the product.
How to shape the separate user interface needs more detailing, some suggestions are shown in figure 28.

Wireless power

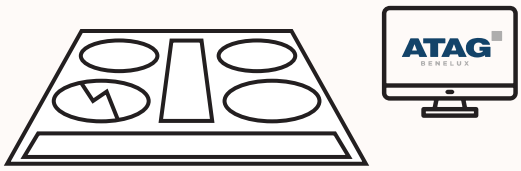
The last expected future upgrade is the development of wireless power in the kitchen. The entire induction module can be replaced for a module with wireless power integrated into it, allowing for the rest of the product to be kept in use.

Figure 28: Three separate user interface suggestions

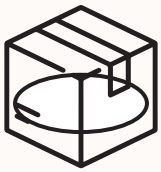
7.3 Service system

Once the induction assembly is easily accessible, it enables faster repair performed by service engineers, but also enables self-repair by the consumer. The consumer has good visual and manual access to the induction assembly. Only a few screws need to be loosened and the induction module unplugged.
This could enable a service system in which ATAG sends replacement parts to the consumer, who replace the broken part and send it back to ATAG. ATAG can then repair the part and use it for the next customer.

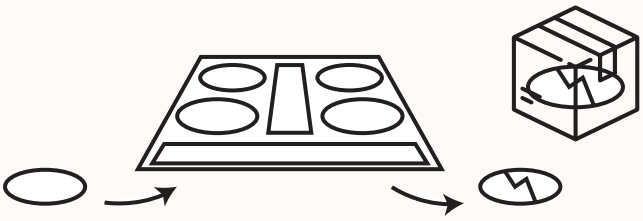
The result would be less down time of appliances, because the consumer does not have to wait for a service engineer to have time to come to perform the repair. The time of the service engineer would be used more efficiently. They only need to travel to the consumer for more complex defects. The simple replacement can be done by the consumer themselves and the repair can be performed at ATAG in a service workplace. Which means that the service engineer needs to spend less time on traveling and can spend more time on performing repairs.
However, for this to work a few other things should be taken into account: the diagnosis, a product passport and a supporting community.



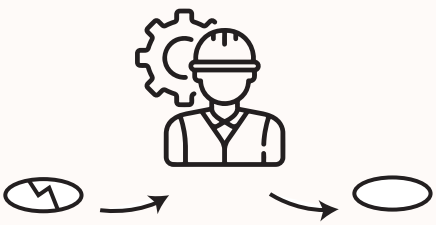
The consumer diagnoses a defect in the product and orders a new part at ATAG, when out of warranty they pay a deposit for the part.



ATAG sends the product to the consumer in a box that can be used to send the defective product back.



The consumer performs the replacement themselves and sends the defective part back.



ATAG repairs the send back parts and use those as again as replacement parts. In case of being out of warranty ATAG pays back the deposit, depending on what is defect and what can be reused.

Figure 29: Servcie system concept

Diagnosis

As mentioned in chapter 2 diagnosis is done using error codes, which point to one, possibly 2, causes of failure. Currently the meaning of only a few of this error codes is share with the consumer. If the consumer is to be enabled to perform repairs themself, they should also be able to make a diagnosis themselves. So first of all, the meaning of the error codes should be easily accessible to the consumer.

Another way of making diagnosing even easier would be if the HIH could send the defects directly to ATAG via the app or use the app to notify the consumer. This way the app or ATAG can actively give advice to the consumer on how to repair the product. The consumer only needs to follow the steps and not actively needs to make the diagnosis themself.

Product passport

If ATAG is going to repair modules like the induction module and sending them to the next customer, it is nice to keep track of what has happened to it. This could be done by giving it a chip, which keeps track of what has been repaired, how old parts get and how it has been used. Over time this makes it possible overtime to predict repairs. With this information they can choose to replace more, before sending it to the next consumer or recycling the whole part.

Community

To support the repair, the diagnosis and the product passport, an ATAG community can be used. The start of this already exists in the form of the ConnectLife app. At the moment this app contains an overview of all appliances, recipes and FAQ.

This could be extended with help video's on how to perform repairs. Also, defects can be immediately communicated to ATAG as suggested above.

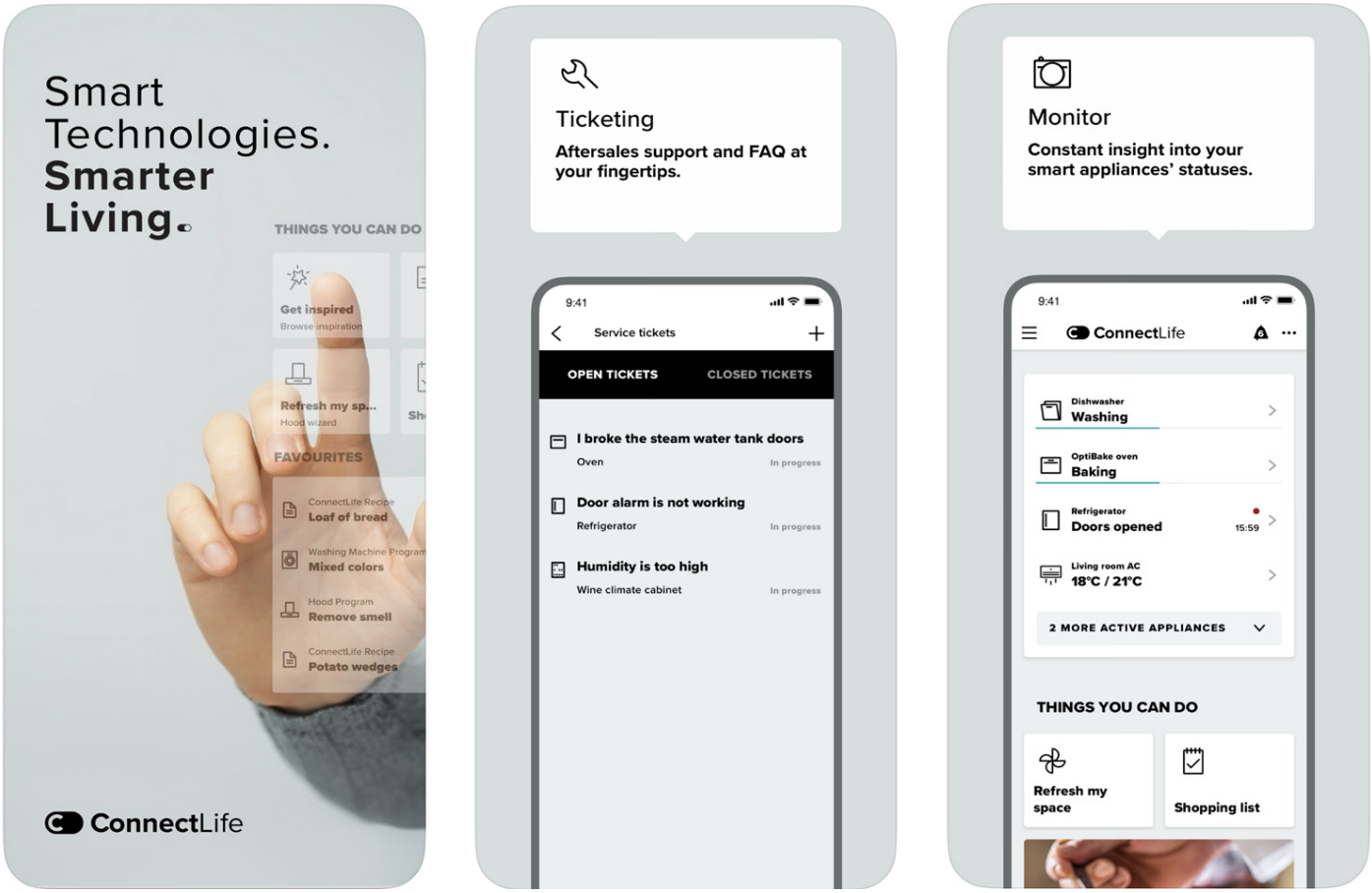


Figure 30: Connect life app (App store, May 2023)

7.4 Second product lifetime

The changes in product architecture in combination with the service system does not only enable the concept to have a longer lifetime, but makes it also more valuable for a second life.
The ease of disassembly makes the concept fit for remanufacturing. In combination with standardized parts, makes that a lot of the parts can be reused.
The concept also has a higher value on the second-hand market, because even when it is broken it is easy to repair. The advantage of second-hand product sold via ATAG is that ATAG can assure the product has a certain quality, by checking it. On top of that a warranty could be provided on the product.

Based on chapter 3 the main reason for not to buy a refurbished product were the hygiene of the product, perceived shorter lifetime of the product and the refurbished product being perceived as less valuable. These last two objections can be overcome by the concept: the quality of the product can be checked and improved by ATAG before selling it. The objection of hygiene can be overcome by cleaning the glass plate and the ventilation duct of the hood thoroughly. The electrical components can be removed beforehand, making this process easier to perform.

7.5 Product journey map

To conclude the concept: the change in the architecture has reduced the number of steps needed to reach parts and has eliminated the most difficult step, removing the product from the counter top, for all priority parts. The easier disassembly enables easier repair and upgradability, which is supported by the service system.

Looking back at chapter 4.2 this concept enables the desired product journey map. The product is easier to repair and has options for upgradability. It prevents replacement due to psychological, functional and technical obsolescent.

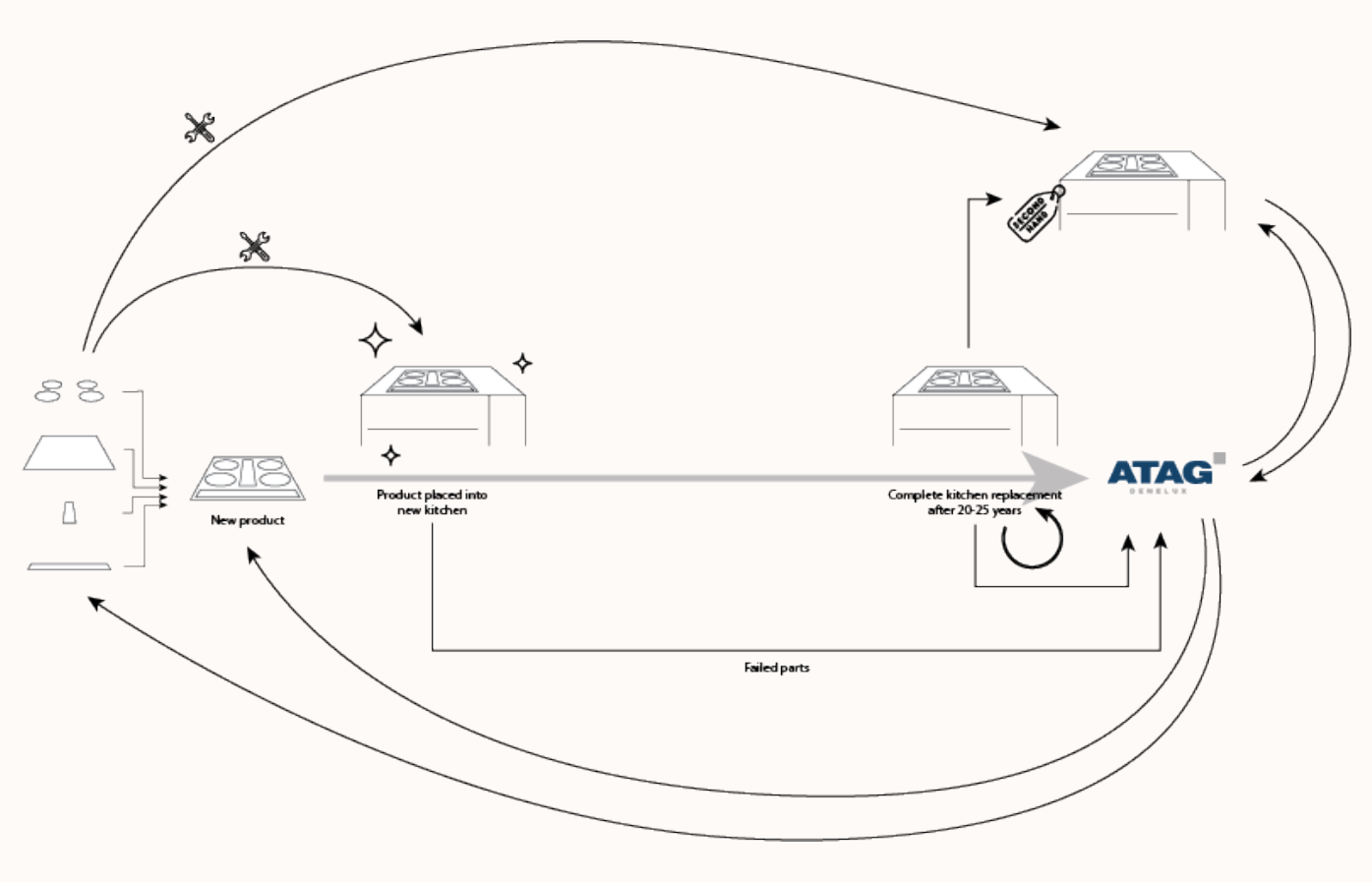


Figure 31: Product journey map concept

8. Evaluation

The main research question to be answered was: How can an induction hob be designed to be fit for the circular economy?
The main research question together with the sub research questions have been answered in chapter 2 and 3. The insights gained were used to form the design vision and the requirements. In this chapter it will be evaluated to which extent the concept fulfils the design vision and the program of requirements.

8.1 Design vision

To design an induction hob that supports a transition from a linear to a circular economy. Showing that with small changes in the design, it can be made easy to disassemble and thus fit for repair and remanufacturing.

Linear to a circular economy

For the concept to be fit for the circular economy it must be fit for the circles of the rainbow diagram. In this project the focus has been on the inner three circles: maintenance, reuse/redistribute and refurbish/remanufacture. For the first and the third circle, the ease of disassembly of the concept is an important factor. This is what the concept is designed for and will be evaluated in the next paragraph. The second circle is dependent on the possibility and the perceived value for a second lifetime. The concept has been made fit to have multiple lifetimes. On top of that is has a higher value for a second lifetime, because the product can be checked, easy to repair and can be upgraded.

Verification ease of disassembly

It was chosen not to make a prototype, but a 3D CAD model. This model was used for a verification with the head service engineer. He has the expertise to evaluate design based on 3D drawing, he is also involved in the design process at ATAG to judge the serviceability. The ease of disassembly was discussed and the visual and manual accessibility.
He was very enthusiastic about the way of disassembly, confirming that all priority parts can be reached within 30 minutes, thanks to the changed architecture. Only needing to loosen screws on the front of the product, is an improvement of the visual and manual accessibility.
On top of that he saw a lot of potential in switching modules and repairing them in a service workshop. Because the time of the service engineer is used more efficiently and products with harder to diagnose symptoms can be examined more thoroughly.

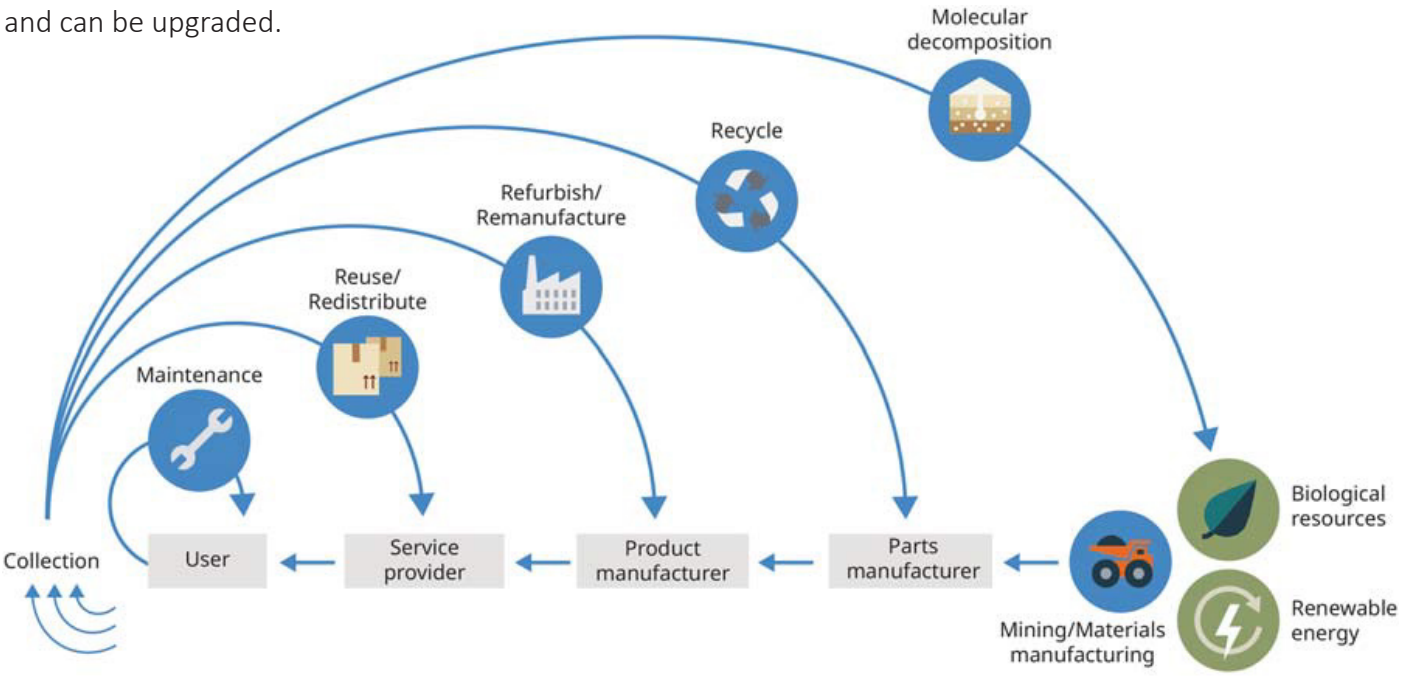


Figure 32: Adapted butterfly diagram, rainbow, (Bakker & Balkenende, 2021)

8.2 Program of requirements

The priority parts must be within easy research: a maximum of 4 simple steps.	This requirement is met to satisfaction. All priority parts can be reached with a maximum of 3 steps, except the glass plate. The glass plate has the biggest risk of damage in transport and when handling it, making it acceptable that it requires more steps to reach.
The design must have good visual and manual access when dis- and reassembled.	This requirement is met and verified by the head service engineer of ATAG.
Defects must be easy to diagnose, pointing to only one or two possibles causes.	Using the same error code system, this requirement is met. On top of that the concept can share the information directly with the consumer and with ATAG. Making the diagnosis even simpler.
There must be no wrong way to perform a dis- and reassembly.	The induction module is form fitted and has a plug, replacing it cannot be done wrong. The more complicated part of the repair is done by ATAG. This can be done wrong, but the chance of a service engineer making a mistake is smaller.
The replacement of any part must be performable within 30 minutes.	For all priority parts, except the glass plate, this requirement is met and verified by the head service engineer of ATAG.
For dis- and reassembly a minimal amount of tools must be needed.	Three standard screwdrivers are needed: TX 15, TX 20 and Philips 2. On top of that a spudger is needed.
All parts must be replaceable without removing the glass plate from the countertop.	This requirement is met for all priority parts. Except for the glass plate, which would be difficult to replace without removing it from the countertop.
Irreversible connections must be avoided.	The product has two irreversible connections: the glue with which the strips are connected to the glass plate and the silicone with which the glass is connected to the countertop. For these connections no alternative was come up with.
Performing a repair must financially be more beneficial than replacing the product.	This requirement is largely dependent on the prices ATAG sets but the concept has the ability to make repairs cheaper: less time of the service engineer is required. On top of that ATAG can reuse most defective module, so the consumer only pays for the part that is replaced.
The extended lifetime that a repair provides must be clear to the consumer.	This can be reached over time, by using the collected data for predictive maintenance. With predictive maintenance the consumer can make an educated guess.
The time of the service engineer must be used efficiently, preferably on performing repairs and not on travel.	This requirement is met for priority parts in the induction assembly.
The replacement of a part ‘just in case’ must be avoided.	This risk is reduced by repairing the product in the service workshop, giving more time and opportunity for testing the repaired part.
The product must be easy to clean.	The glass plate and the ventilation duct of the hood need to be cleaned thoroughly. To make this easier the electrical components can be removed beforehand, making the cleaning process easier.

8.3 Recommendations

The concept can be used as a showcase for how simple changes can make a design more circular. However more research and iterations are needed, these will be presented here.

User willingness

No verification has been done with users about their willingness to perform part of the repair themselves. Based on literature, requirements were formed to enable the user to perform part of the repair themselves: there must be no wrong way to perform a repair. The concept tries to enlarge the consumer confidence; however nothing can be said about their willingness. Particularly when the product still has warranty, the consumer may find it safer to let the service engineer do the complete repair. To verify and improve this, user testing should be done.
Another point that needs user testing is the willingness to keep the product after replacement of the kitchen. At the moment consumers do not even consider keeping their product. The concept overcomes a possible barrier by being upgradable, but more user testing is needed.

Recycling

To make the product completely fit for the circular economy the recyclability of the design needs attention. In this project the focus was on the inner circles, but when a part fails or the product is at its end of life the materials will need to be recycled.

User interface

In the concept the user interface is taken out of the product and has been made a separate unit, to have more upgrade freedom. How to shape this separate unit needs attention.

Keep improving

This concept demonstrates how to improve a small part of the product. However, further exploration into other parts of the product is recommended. For example, the critical part in the hood is reachable within 4 steps, but the visual and manual access could be improved.

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10. Appendix

A. Project brief
B. Interviews
    Questions
    Coding
C. Creative session
    Slides
    Generated ideas
D. Ideation module connection

TU Delft

Design of a Circular Induction Hob

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 21 - 11 - 2022

28 - 04 - 2023 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Currently the market of kitchen appliances has a linear life cycle: appliances are produced, used and then disposed of. 80% of all e-waste is household appliances of which 70% was recycled in 2021.
More than 30% of the Dutch population cooks on induction hobs and over half of the new bought hobs are induction. Most of these hobs are replaced before they break down, because the consumer remodels the kitchen, including build in appliances.

I am going to do my graduation project for ATAG Benelux. ATAG Benelux is part of the Hisense group and sells the brands: ATAG, Pelgrim and ETNA in the Netherlands and Belgium.
ATAG Benelux is exploring options to realise a circular business, in line with the ambition of the Dutch government to have a circular economy by 2050.
The three P's (people, planet, profit) are used as a guide. At the moment a pilot is planned with preventive maintenance to prolong the products life. ATAG is also working on smarter/connected products, in order to be more energy efficient and waste less food.
Next to the three P's ATAG focusses on 5 SDGs: 3: Good health and well-being, 7: Affordable and clean energy, 11: sustainable cities and communities, 12: Responsible consumption and production and 17: Partnerships for the goals.

The other important stakeholder of this project is the consumer. The brand ATAG is focusing on added value for the consumer in the higher segment, including high tech options for the user like temperature controlled cooking. The high quality and the added value is what the consumer buys ATAG for.

space available for images / figures on next page

introduction (continued): space for images

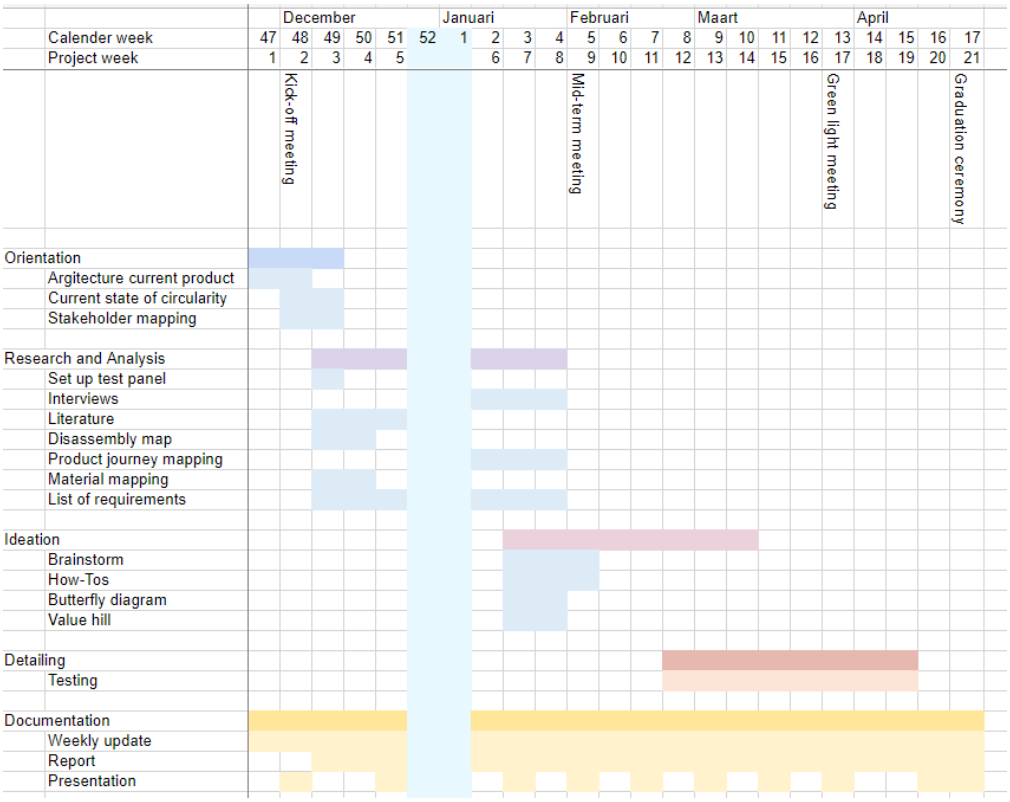
image / figure 1: ATAG Celsius°Cooking™ induction hub

image / figure 2: ATAG hood in Hob

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 21 - 11 - 2022 28 - 4 - 2023 end date



I am going to work part time for the first 10 weeks, I will be following my last elective on Fridays for half a day. The total of these 5 days I will compensate by working 1 week extra.

My gantt chart consists of 4 main phases, below I will describe what the goal of each phase is. The first phases are more detailed than the later phases, this is because I expect that at the end of each phase I will have insides I do not have now. So each phase will be more detailed after the phase before it comes to a close.

Orientation
The goal of orientation is to get more insight into what to do in the research and analysis phase. Having more understanding of the current design.

Research and Analysis
The goal is to gain information of what the design should take into account. Create a back bone for the design.

Ideation
To create a lot of options that could solve (part) of the problem. Resulting in multiple concepts

Detailing
Choose one or two concepts to detail and test the concepts with relevant users. Resulting in the final design.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

I choose to set up this graduation project because I want to do a complete design process, from research to a final design. On top of that I want to work on a consumer product, because I want to include the consumer behaviour into the design. Last but not least I want to include sustainability, this project of designing a circular consumer product includes all the above.

A personal ambition is to dive deeper into the butterfly diagram and the value hill to use as tools. I have used them before, but only fleetingly.
Another personal ambition is visualisation, I did multiple drawing electives. I want to put this knowledge into practice and hopefully improve my skills.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

B. Interviews - Quesitons

Set up

The interviews were conducted via the phone and recorded.
First a pilot interview was done to check if the desired information was collected and if the information is sufficiently in-depth.

> Pilot interview insides:
> Interview with participants who replaced their kitchen took about 5 a 10 minutes
> Based on the interview information was collected to give insight into product care, replacement behaviour and acceptance of refurbished products.
> Participants share their thought process, what their emotions towards the product are/were.

Boundary conditions

Participants

- Dutch
- Home owner or more expensive rental homes (with own kitchen)
- Replaced an appliance or entire kitchen

Kitchen appliances:

Preferably replaced an induction hob, otherwise should have the same level of complexity and be a build-in appliances. Preferably no dishwasher, fridge or wine cabinet. No washing machines or dryers and no small appliances as an air fryer or coffee machine.

Interview questions

Basic Questions

- Did you only replace one product? Or more in/of the kitchen?
- What product did you replace and for what did you replace it?
  - Kind of product
  - Brand

Kitchen retailer

- How long are kitchen appliances in use?
  - Is that longer or shorter than the expected lifespan?
- What is the status of the appliances when they are replaced?
  - Broken? (Can not perform its main function)
  - Malfunctioning? (Can perform its main function, but is damaged in another way)
  - Repairable or beyond repair?
  - Wear and tear?
  - Good as new?
- What happens with the appliances that are taken out?

Users, of HIH

7 users available in total, all field tests

- Can you tell me about your decision process of participating in in the field test?
  - What is the expected value of the product?
- Do you perform maintenance?
  - If yes: what?
  - If no: why not?
- Would you call for repair?
  - Within warranty?
  - After warranty?
- Would you repair yourself?
- What would be a reason for you to replace?

Users, who replaced their kitchen appliances

- Could you describe the most recent replacement of a kitchen appliance?
  - What was the thought process you went through?
  - How long was your decision making process?
- Can you tell why you replaced the product?
  - If broken:
    - In your opinion what was the reason that caused the broken issue?
    - Broken or malfunctioning?
    - Was it already repaired once or multiple times?
    - Did you consider repair?
  - If not broken
    - Why replaced?
    - Pushed away from this product?
    - Pulled towards another product?

- How old was the product? How do you feel about the actual lifetime of the product? How long do you think it should have lasted?
- How did you deal with the product after replacement?
- You describe you did … with the appliance, did the appliance still hold value in your eyes? What kind of value?
  - For example in terms of money or emotional
-
- How do you judge the quality of a product? What do you pay attention to?
- Do you consider refurbished kitchen appliances?
  - What are the benefits or risks it may bring?

Coding

Code group	Codes	Quotation
Product care	Clean the glass plate everyday	na het koken iedere. Dag, wat ik ook laat sc
Product care	Cleaned two times since purchade	Maar dat is eigenlijk ook maar twee keer ge
Product care	Cleaned when it is visable dirty	We krijgen altijd een melding binnen wann moeten worden. Meestal voordat ik de mel het zelf al gedaan.
Product care		En een keer In de week en en dat die glaspl lekker Als we denken, er moet weer wat. Hi
Product care		Nu heb je de hood in de hob, dus je ziet die
Product care		Als ik hem er vies uit vind zien
Product care		Wij maken best wel goed schoon als in den erin zitten.
Product care	Cleaning method	Die kun je eruit pakken en dan kun je hem e
Product care		Gaat In de vaatwasser erg goed
Product care		gewoon in een hete sopje gezet, zodat het
Product care		Vetfilters zetten we een keer In de zoveel ti
Product care		Dus ja dat bevalt wel goed, want wat ik ook teem gewoon In de vaatwasser kan zetten
Product care		Die gaan elke 3 weken In de vaatwasser.
Product replacement	Appliances were replaced during the kitchen lifetime	We first had a halogeen hob. And, now we
Product replacement		Deel van de apparaten zater er vanaf het be keer vervangen. De afzuigkap die was al een nog origineel. De vriezer was kapot, die heb combimagnetron was ook nog orgineel. Tw rest was al een keer vervangen.
Product replacement		Ik heb eigenlijk nog niet zo lang een inducti
Product replacement		Ja, ja, Dat was wel iets nieuwer, maar ja, nie
Product replacement		Dus Als het dan toch aan vervanging toe zij elektriciteit, dus dat is eigenlijk het uitgangs
Product replacement	Easier and cheaper to buy a new product	Het was makkelijker en goedkoper om iets
Product replacement		En ja voor het dubbele heb ik ook. Een heel
Product replacement		Maar ik ben nadat ik bij 4 adressen een offe tot de conclusie gekomen dat ik net zo goed omdat dat maar €5.000 A € 6.000 duurder jk best een grote keuken. Als ik maar 5 à € 6 nieuwe keuken, dan wil ik nu ook gewoon v
Product replacement		Ja, dat doe ik gewoon een ja, een break eve
Product replacement	Very different product lifetime expecta-tions	you want it to last at least 10 years or 15 ye
Product replacement		Want ook hij mag hij mag. Er weer 25 jaar r
Product replacement		Omdat je ook weet dat een apparaat gemid
Product replacement	Gas is percived as having a longer lifetime	If you compare that to a gas stove, of cours life and that went from mother to daughter doesn't last as long I think. In proportion, b right?

	Quotation translation
hoongemaakt	
eraakt. Sinds een jaar tijd dus?	
eer de vetfilters schoongemaakt lding gedaan wordt, dan hebben we	We always receive a notification when the grease filters need to be cleaned. Usually before the report is made, we have already done it ourselves.
laat, die doen we met glassex. Ja ij is een beetje vies.	
e goed.	Now you have the hood in the hob, so you can see when it needs cleaning
k dat de filters in een lek bakjes die	
even schoon spoelen onder de kraan	
vet eraf weekt	
jd In de vaatwasser	
k heel fijn vind is dat je de afzuigsys-	
have an induction hob.	We first had a halogeen hob. And, now we have an induction hob.
egin in. Fe kookplaat, die was al een n keer vervangen. De koelkast was bben we toen niet vervangen. De ee apparaten waren nog orgineel, de	Some of the devices were in it from the start. The hob had already been replaced once. The extractor hood had already been replaced once. The refrigerator was still original. The freezer was broken, we didn't replace it then. The combi microwave was also original. Two devices were still original, the rest had already been replaced once.
ekookplaat.	I actually haven't had an induction hob that long.
et meer van. Deze tijd.	
n, dan wil ik de gas vervangen door spunt nu.	
nieuws aan te schaffen	It was easier and cheaper to buy something new
l koopwaar bij wijze van.	
erte had opgevraagd over renovatie d de nieuwe keuken kan nemen, is dan een renovatie. Ik heb nameli- 6.000 meer moet betalen voor een wel eens een hele nieuwe keuken.	After I had requested a quote about renovation from 4 addresses, I came to the conclusion that I might as well take a new kitchen, because that is only € 5,000 to € 6,000 more expensive than a renovation. I have quite a large kitchen. If I only have to pay 5 to € 6,000 more for a new kitchen, then I just want a whole new kitchen.
en Point	
ears, right?	you want it to last at least 10 years or 15 years, right?
niet zijn?	
ddeld 8 a 9 jaar oud wordt	Because you also know that a device is on average 8 to 9 years old
se that lasted more than a human r, didn't it? Yes, this kind of thing ut 20 years is still quite a good age	If you compare that to a gas stove, of course that lasted more than a human life and that went from mother to daughter, didn't it? Yes, this kind of thing doesn't last as long I think. In proportion, but 20 years is still quite a good age right?

Product replacement	The appliances were not perceived as valuable at the end of life	Die hebben we helemaal uit elkaar getrapt.
Product replacement		En, Ik kan niet anders naar de stort brenger in heeft.
Product replacement		Ja, weet je het is zo oud. Ik denk niet dat ie wordt door het keukenbedrijf gewoon afge
Product replacement	Participants feel they deserve a new kitchen	Ja, want Dit is een beetje de. Dat klinkt wat zo van. Nou, dat zal dan mijn laatste keuken ook leuk, ik zie het niet zo dramatisch.
Product replacement		Ik heb dit geld ervoor uitgetrokken. Ik heb d denk niet dat ik voor iets refurbished zou ki
Product replacement		Het is wel onze laatste keuken. We hebben willen we graag een mooie nieuwe keuken
Product replacement		Omdat ik nu de keuken helemaal krijg zoals niet zou hebben gedaan.
Product replacement		zelf gespaard hebben voor een keuken die v nou? In gedachten hebben.
Product replacement		Ja dat dat. Omdat we daar nu ook gewoon dat. Ik zoiets. Heb, nee, Ik ben niet zo van. I
Product replacement	Old kitchen was not percived as having value left	En de keuken was wel een beetje oubollig,
Product replacement		allemaal eigenlijk naar de afvalstof.
Product replacement		Nee helemaal niet.
Product replacement		Het is gewoon afgevoerd.
Product replacement		die was een beetje gedateerd
Product replacement		Afgevoerd als ja, als wat? Doe ja ja, die het rest van. Is dat, ja is dat gewoon weggegaar
Product end of life	Old products were given away	de ja deels naar familie gegaan.
Product end of life		Kijken of ik iemand er een plezier mee kan
Product end of life		De vaatwasser een miele, die is nog een ha
Product replacement	Replace kitchen because te appliances were failing	Nou de apparatuur begeeft
Product replacement		Mijn oven veroorzaakt kortsluiting, mijn ker voor de rest werkt het allemaal nog. Maar j aan vervanging toe dacht ik.
Product replacement	Replace when the kitchen will be re-placed	of een compleet nieuwe keuken natuurlijk
Product replacement	Replaced the enitre kitchen because of remodeling	De hele beganegrond verandert, dus kwam
Product replacement		Dus Het was een algehele opknapbeurt van
Product replacement		We hebben de hele keuken vervangen, en t
Product replacement		Nou, Omdat de of. We hebben gewoon de l ieping omgegooid, dus Het was een heel kl uitgebroken dus. Zit gewoon heel anders.
Product replacement		Nou, Wij zijn verhuisd naar een nieuw huis En vandaar dat we graag een nieuwe keuke
Product replacement		Ja, Wij hebben ons hele huis verbouwd, du
Product replacement		Mijn huis is ook vrij nieuw,
Product replacement	Replacement when something new would come to the market	Als er iets heel revolutionairs op de markt k

Ja, ja.	
n, zeg. Maar dat is Niemand interesse	
mand anders dat nog wil. Dus het voerd.	Yeah, you know it's already so old. I don't think anyone else wants it. So it is simply disposed of by the kitchen company.
dramatisch, Maar het is een beetje n zijn die ik zelf uit ga zo. Ja, dat klinkt	
dit geld er nu ook voor over, dus Ik iezen nee.	I've saved this money for it, so I don't think I would opt for something refurbished, no.
het er nou voor gespaard en nou die we zelf uitgezocht hebben.	It will be our last kitchen. We have saved for it and now we would like a beautiful new kitchen that we have selected ourselves.
ik dat wil, Ik weet zeker dat ik dat	
we zelf helemaal willen. Zoals wij	
hard voor gespaard geven, maar dan Het refurbish.	
niet meer van deze tijd, zeg maar.	And the kitchen was a bit old-fashioned, no longer of this time, so to speak.
	It was all disposed of
	It was all disposed of
	It was quite old-fashioned
gewoon afgebroken. En ja, met de n.	
	Parts went to family
doen	See if I can do someone a favor with it
rtstikke goed	The dishwasher is a Miele, which is still very good
	The appliances are falling apart
ramische kookplaat is gebarsten. En ja, Het is gewoon algeheel een keer	My oven is short-circuiting, my ceramic hob is cracked. Everything else still works, but Ï thought it was just time for a complete replacement.
	Or when the kitchen is replaced ofcourse
alles op een andere plek	The whole ground floor is changing, so everything came in a different place
n de Van de begane grond.	
toen dus ook een nieuwe kookplaat	We replaced the entire kitchen, so also a new hob
hele indeling van de benedenverd- ein keukentje en We hebben muren	
en daar zat een hele oude keuken in. n wilden.	
s vandaar ook een andere keuken.	We renovated the entire house, so also a new kitchen
komt.	When something really revolutionary comes on the market.

Product replacement	replacement when the product does not look pretty anymore, wear and tear	Als ik dat helemaal niet meer uitziet dat hij verschrikkelijk lelijk is geworden.
Product end of life	Sold old product	We sold it on Marketplace
Product end of life		We hebben verkocht, dus We hebben dat M opgehaald
Product end of life		Nou ja, onze apparatuur is nog best goed, d voor betalen.
Product end of life		Nee, want Ik weet zeker mijn mijn mijn afw
Product end of life		Ja, Dat is heel erg jammer. Dat is een heel, l maar het heeft een goede plek gekregen vi
Product replacement	The kitchen was not that old, but the qualtity was not that good	En, Dat was nou die keuken is. 12 13 14 jaa kwaliteit
Product replacement	The kitchen was old, so it needed to be replaced	Ik had een nieuw huis en er zat een keuken moest gewoon een nieuwe keuken in.
Refurbish barriers	Hygiene	Ja, het moet wel echt schoon zijn
Refurbish barriers	Precived shorter lifetime	because warranty is usually half a year or a
Refurbish barriers		Would you dare to do it with a longer warra I would, I would consider it.
Refurbish barriers		Ja weinig vertrouwen is wel levensduur. De
Refurbish barriers		Ja, geen idee eigenlijk, Dat is. Denk ik een b
Refurbish barriers		Als het bijvoorbeeld € 600 is in plaats van 1 moeite waard. Ik zie toch refurbished gevoe Het is misschien wel onzin.
Refurbish barriers	Prefers a new appliance	Ja, nou ik heb wel refurbished telefoons bij vind ik toch wat anders, denk ik.
Refurbish barriers		Ik heb toch het? Liefste heb ik een nieuw ap
Refurbish barriers	Testing	Als je weet dat het product goed getest is
Refurbish barriers	Wear and tear	Als het gewoon goed uitziet en er zitten ge gewoon netjes
Refurbish barriers	When you go to a kitchen retailer it is expected that you buy new appliances	Dus ja, dan zou ik al via. Iemand moet doen
Refurbish barriers		a ja precies ja Als de Graafschap zitten Natu trainer kan gaan, dat scheelt, want Het is. N
Refurbish barriers		Als je naar zo'n keukenboer gaat, dan. Hoor uur koopt. We hebben echt niet overwoger zitten om te hergebruiken.
Refurbish barriers		Ik zou wel de apparatuur mee vervangen. H je dan alles nieuw hebt, heb je ook meteen
Refurbish barriers		Ja het had nog wel even meegekund. Maar gezocht.

zoveel gebruikssporen heeft dat hij	When it has a lot of wear and tear.
	We sold it on Marketplace
Marktplaats gezet en het. Is allemaal	We put it on Marktplaatas and some people came to collect it.
dus dan wil iemand daar vast nog wel	Well, our equipment is still pretty good, so someone is probably still willing to pay for it.
asmachine is nog prima	
heel mooi gasfornuis met ovens, a Marktplaats.	
r oud was het niet zo'n goede	
in van jaren 80. Ja ik dit. Ja dus er	I had a new house and it had a kitchen from the 1980s. So it just needed a new kitchen.
	Yes, it must be really clean
year and these types of products	
anty? Would you consider it ? IB Yes,	
nk ik?	Yes, little confidence is longevity. I think?
bepaald gevoel of zo?	
1000, dan vind ik het wel weer de elsmatig een beetje als een gokje.	For example, if it is € 600 instead of 1000, then I think it is worth it . I still see refurbished as a bit of a gamble. It might be nonsense.
voorbeeld. Maar keukenapparatuur	Yes, well I do have refurbished phones for example. But I think kitchen appliances are something else.
pparaat	
	If you know that the product has been properly tested
en krassen op en het is allemaal	If it looks good and there are no scratches and it's all just neat
uurlijk geen probleem en als dat een Niet verkoop allemaal.	
rt vanzelf bij dat je ook die apparat- n om de oude apparatuur te laten	If you go to a kitchen retailer, then it goes without saying that you also buy new appliances. We really didn't consider leaving the old equipment to reuse.
Het is ook meer met het idee van dat op alles volledig garantie	I would replace the equipment. It is also more with the idea that you have everything new, you also immediately have a full warranty on everything
goed, Ik heb nu alles nieuw uit-	Yes it would have lasted a while. Well, I've got everything new now.

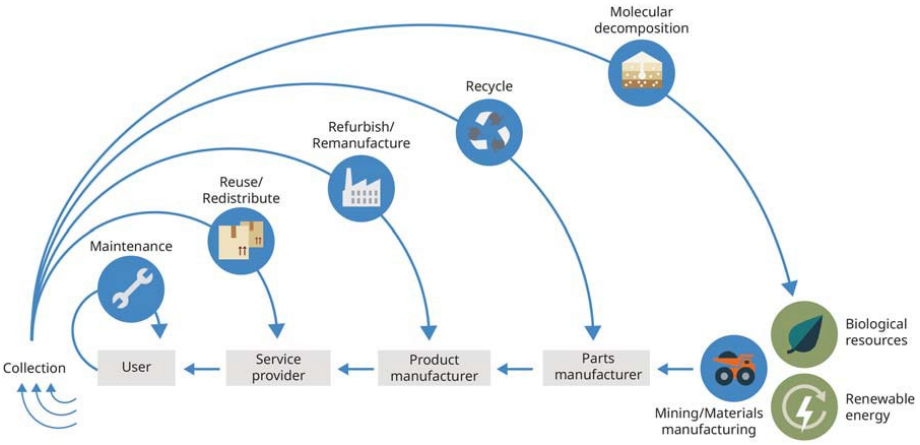
Refurbish motivators	Already buy a lot second hand	Oh, dat zijn we heel erg zeker. We kopen he bished zouden we zeker wel voor in zijn,
Refurbish motivators		Want ik merk ook dat ik steeds meer dinge
Refurbish motivators	It can always be repaired	Ja ook wel, apparatuur is altijd wel te make
Refurbish motivators	It is better for the environment to use second hand products instead of every-thing new	Sterker nog, vinden we de juiste? Heel goe
Refurbish motivators		ar. Alle milieu en alles dat je dan toch ziet d len snel weggooien. Weer nieuw denk van kunt opknappen en her kunt gebruiken, da heb je wel meer afval. En dus, dat zou ik ze
Refurbish motivators	It is cheaper	Alle kosten
Refurbish motivators		Ja, en als ik het op Marktplaats dan doe ik h even geduldig zoek is net zo goed. Ik denk grijk is, dat er een groot prijsverschil is
Refurbish motivators	Probably better for the environment, but mostly because it is cheaper	Het is vast beter voor het milieu en zo. Maa bezig. Eerlijk gezegd, het is voornamelijk da
Refurbish motivators	The kitchen is also 10 years old, so the hob also does not need to be new	De keuken is ook niet nieuw. Meer is. Ook 1 uit, hoor, maar dus. Ik ik, ik hoef niet per se
Selecting new appliances	Afraid of noice	beetje bang dat deze. Heel veel lawaai zou
Selecting new appliances		En, dat vonden we nog wel spannend
Selecting new appliances	Availability	Maar het verkooppraatje hield die die gaf d en Etna kan ik je garanderen dat we binnen hebben.
Selecting new appliances	Brand	So that and the brand Because yes, that Ne something like that again. Then it became E So yes, so then we thought ok. That's what
Selecting new appliances		el. Als je Siemens.
Selecting new appliances		En de de kookplaat is een bora.
Selecting new appliances		Nou Mensen heel bewust voor dat merk, ze
Selecting new appliances		k denk dat ik naar merk kijk, dat ik zeg maa
Selecting new appliances	Easy maintance	En er werd ons verzekerd dat hij goed af zo onderhouden is
Selecting new appliances		, We hadden de eerste alle altijd gas. Iets, d kelijk schoonmaken Natuurlijk.
Selecting new appliances	Energy use	an induction is more environmentally friend
Selecting new appliances		Energiezuinig de apparatuur
Selecting new appliances		gezien de hele gebeuren met gas en met Ru eigenlijk de reden Waarom We hebben gez zoveel mogelijk alles een beetje absoluut d dus We hebben zonnepanelen en.
Selecting new appliances		Hoe kunnen we zeg maar de gasrekening n
Selecting new appliances		Ja op lange termijn lange termijn investerin zaamheid op de lange termijn.
Selecting new appliances	Integrated hood	Eigenlijk dat het toch beter uit zag.
Selecting new appliances		zo'n een ingebouwde afzuiger
Selecting new appliances		Een voordeel is natuurlijk dat je geen afzuig
Selecting new appliances		Midden afzuiging wat ik erg mooi vind, war meer

eel veel tweedehands, dus refur-	Oh, we're very sure. We buy a lot of second-hand, so refurbished we would certainly be up for it,
n van Marktplaats haal,	I also notice that I get more and more things from Marktplaats,
n, dus ja, dat dat zal wel goedkomen.	
d.	
at heel veel Mensen daar alle spul- nou als oude spullen dat je die weer n sta ik Alleen maar voor op. Anders ker wel. Is openstaan.	
net voor 1/4 van de prijs en Als ik dat voor mij de prijs altijd heel belan-	Yes, and if I do it on Marktplaats then I do it for 1/4 of the price and if I look patiently it's just as good. I think for me the price is always very important, that there is a big price difference
ar ook dat ben ik niet zo heel erg mee t het minder kost.	It's probably better for the environment and stuff. But I don't I am not so involved in that. Honestly, it's mainly that it costs less.
10 jaar. Oud en er zit vaak nog prima	
maken.	
luidelijk aan met Attach en pelgrim 3 maanden dat materiaal allemaal	
ff was just fine, so then we want Bosch. Yes, we have the same oven. we do.	So that and the brand Because yes, that Neff was just fine, so then we want something like that again. Then it became Bosch. Yes, we have the same oven. So yes, so then we thought ok. That's what we do.
eg maar ja we	
r a merk wil.	I think I'm looking at a brand, that I want a premium brand.
u zou en dat het heel makkelijk te	
lus Dit is in die zin heel fijn en mak-	We had an gas cooktop first. So This is much more easy to clean.
dly and that it uses less Energy.	an induction is more environmentally friendly and that it uses less Energy.
usland en allemaal op. Dus Dat is egd van. Dat we We hebben Huis al oen tijd probeert te verduurzamen,	
aar beneden.	
g, zeg maar. Met het oog op duur-	Yes, long-term long-term investment, so to speak. With a view to long-term sustainability.
	Iit looks better.
gkap erboven hebt	An advantage is of course that you don't have an extractor hood above it
t je hebt ook geen bovenkasten	Central extraction which I think is very nice, because you no longer have wall cabinets

Selecting new appliances	Looks	Yes, in terms of design. Well, not, not super
Selecting new appliances		En dan komen de leuke dingen Als de kleur plaats te verder indeling.
Selecting new appliances		We wilden zwarte apparatuur
Selecting new appliances		Maar we vonden deze het mooiste dus een a
Selecting new appliances		Dat is allemaal bekeken en mijn keuze is ge ie, strakke lijn
Selecting new appliances		gecharmeerd van Van design en rood van V
Selecting new appliances		kook fornuis gezien, die heb ik gezegd tegen wil ik hebben, want dat zag ik eerder op Ins fantastisch mooi.
Selecting new appliances		Omdat die fantastisch mooi is.
Selecting new appliances		Natuurlijk wel mooi uitziet en dat het dan h qua technische redenen.
Selecting new appliances		de landelijke stijl, zeg maar, en daar hebben ook naar uitgezocht
Selecting new appliances		Nou die paste mooi in het plaatje.
Selecting new appliances	More space desired	now I have taken an induction with such a s
Selecting new appliances		because of the way those circles were at the lems with the stem of a saucepan, that I cou
Selecting new appliances		Watched more of that fishpan would fit
Selecting new appliances		Grote pitten kunnen gebruiken.
Selecting new appliances	New kitchen is nothig special	Een beetje standaard. Allemaal? Het is geen
Selecting new appliances	Power	capaciteit wel redelijk wat vermogen heeft,
Selecting new appliances		Ik kijk naar vermogen, want ik wil ook graa urlijk minder makkelijk. Dat gaat iets mind

, not super looked at	
rtjes het materiaal van de paarden	
	We wanted black kitchen appiances
afzuiging In de. In de inductieplaa	
vallen op atag. Ik vind dat een moo-	
Van de. Hoed in op.	
n een meneer van de winkel. Die stagram voorbijkomen. Vond ik zo	
	Because it is fantastically beautiful.
helemaal In het plaatje past, maar niet	
we. Het fornuis in. Dus de couplet	
	Well, it fit nicely into the picture.
space that the fish pan can fit well	
halogen then I sometimes had prob- uld put another pan next to it	
. Echte luxe dingen aan	
	capacity has a reasonable amount of power,
ag kunnen wokken, dus dat is natu- er makkelijk op inductie.	

C. Creative session - slides



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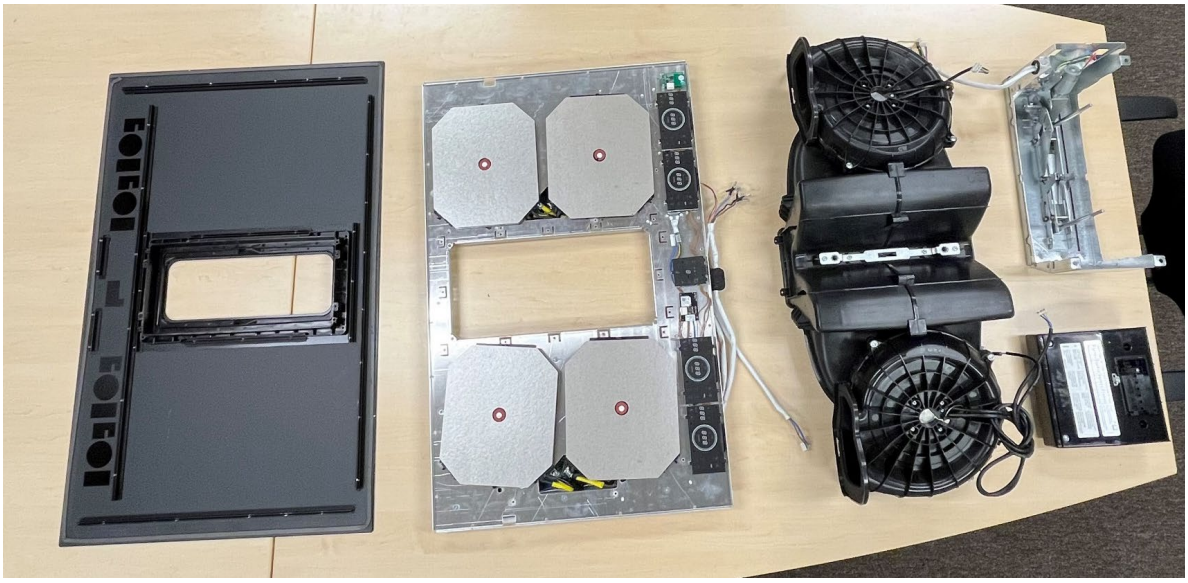

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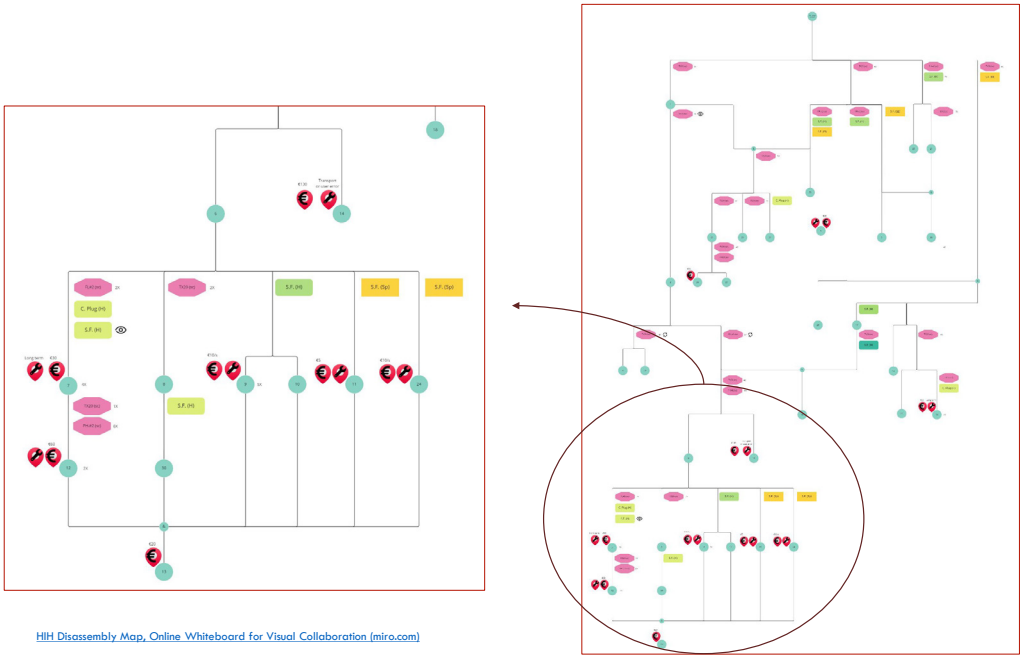


HIH Disassembly Map, Online Whiteboard for Visual Collaboration (miro.com)

6

REASON OF REPLACEMENT

How to make the hood in hob ready for the next 50 years?

FUTURE VISION

BRAINSTORM

‘How to…’ solve parts of problem

Combining ideas

Concept presentation

10

BRAINSTORM REGELS

Don’t say ‘no’, say:

yes, and…

Write down everything, noting is to crazy

Quantity

11

HOW TO…

…MAKE A HOOD IN HOB THAT IS FIT FOR THE NEXT 50 YEARS IN TERMS OF…

… the interaction with the user

… prolong lifetime

… user wishes

… new functions

… upgradability

… fit for repair

… looks

12

BRAINSTORM

3 minuten per paper

Yes, and...

Write down everything, noting is to crazy

Quantity

13

CREATIEVE SESSIE

Break

IDEATION

Look at the papers together

Place a dot at the ideas with the most potential

Combi ideas

15

CONCEPT DETAILING

Detail 1 concept

Make a poster

Present concept

16

CONCEPTEN

17

CREATIEVE SESSIE

Thank you for the participation!

C. Creative session - generated ideas

(Geschikt voor reparatie)
virtueel repareren
helpt met repareren
mogelijk verschillende
...stechnieken
Toegang
Voorraad aan 2e hands componenten
- werkplaats voor 2e hands componenten
...atie — Minimaliseren van componenten
Modulair Maken
Makkelijk te veranderen
Makkelijk te repareren
...ysteem voor ...t meldingen
...nnect met app

Hoe kan je ... upgradability

- interface makkelijk te vervangen
- ruimte voor nieuwe functies
- mogelijkheid voor het verbinden van nieuwe apparaten of robots
- oude apparaat inleveren en bijv. korting op nieuwe
- glasplaat niet van glas maken
- keuken apparatuur laten "samenwerken"
- software updates voor interface / inductie techniek (bv. nieuw automatische programma's)
- koppelbare accessoires die beleving vergroten
- implementeren wireless power na upgrade
- vervangen UI door projectie op werkblad

terugkoppeling oude AI geproduceerde producten!
hun je die ook connected maken?
Wat is daar voor nodig?
Kitchen as a Service
Statiegeld?
Geld terug aan einde levensduur
Mensen gaan bewuster om met spullen
Fabrieken willen betere kwaliteit
3D printing accesoires (Miele 3D print)
← Technent = Monteur
Reasops software bedrijf techy
Aansluiting oorspronkelijk ook zelf produceren

...nctiestoepassen?
Telefoon verbonden
recepten
door fabrikant
door community
door 3e partijen
voorlezen
Onderdelen toevoegen
Producten
gewoontes opslaan
alles-in-1
air cleaner functie
air conditioning

Hoe kan je ... nieuwe functionaliteiten

Snijden op de kookplaat
BBQ / Grillen
praten / luisteren ← Tekst gestuurd? Implementeer standaard microfoon, camera & dig. interface voor als die nieuwe functionaliteit komt. Design sessie over keukens toekomst
Recepten laten koken ← speciale recepten die dat kunnen
Sneller koken ← zelfkokende pan
Gooi alles in 1 pan, keuken doet de rest
Op werk koken ← Deelkeuken
keuken is de service
Je hebt thuis een ATAG? Zijn speciale ATAG keukens waar je altijd mag koken
koppeling / met andere apparaten (koelkast, oven, etc) samenwerken
Via cloud updaten en nieuwe functionaliteiten ontsluiten

Kookplaat gaat op in omgeving wanneer die niet gebruikt wordt.
Keuken kan in verschillende kleuren patronen veranderen
Allergiën

Hoe kan je .. de interactie met de gebruiker

Service
Maak het onafhankelijk voor de gebruiker zelf dingen te repareren → via spraak koelkast die zelf praat?
predictive maintenance → apparaat geeft zelf vroegtijdig aan als iets kapot gaat
- aangeven wanneer mogelijke verbeteringen beschikbaar zijn voor de kookplaat (voor de gebruiker)
Wat is het doel van Connected
Laat zien hoe het bijdraagt aan besparing
expliciet extra waarde toevoegen
↳ Chef kok implementeren in Smart Systems om te laten zien hoe je het beste kookt
Schoonmakers hoe je schoonmaakt
Monteurs hoe je repareert
zoals AI / chatGPT

Klantwens
leer de gebruiker kennen
feedbackloops in de software
Algoritme's die het best bij je aansluiten
Goals bij social media
een onervaren persoon laten koken als een Chef
maatwerk, functies die de klant wilt integreren
koppel UI aan wensen gebruiken.
- Visueel beperkten met voice
pas functionaliteiten aan voor type gebruiker
↳ Chef kok
Beginner
gevorderde
etc.

...ruiker voorziet van eten
...ijdig aan wanneer iets
...pparatuur ook nodig heeft
... hergebruiken (via bv leverancier).
↳ bv. generaties inductie.

Hoe kan je ... geschikt voor reparatie

AI die je aan kan sturen
'Dat onderdeltje vervangen ...'
Scannen voor camera of je juiste onderdeel hebt.
Geeft uitleg hoe je moet vervangen
kan mogelijken via speciale camera/app

Reparatie workshops
Ipv Service aan huis, kom naar Reparatie workshop. Leer je over beginselen van repareren

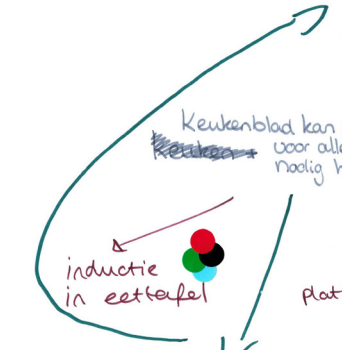
Proberen veel dezelfde onderdelen te gebruiken.
onderdelen die vaak stuk gaan makkelijk te vervangen.

makkelijk uit neem baar zodat deze terugte stu ren is naar fabriek

de kookplaat kan laten zien wat er kapot is

Gamification

HKJ koke



geïntegreerde kook
kookplaat
onder keukenblad
Zonne Energie
gebruiken voor koke
verwarmen

HKJ

HKJ
- Hoe kan je
- Keukens delen

Buren koken elke
vaak elkaar

Het maken van een
buurtbewoners eetpl
kunnen aangeven.

vervolgens kan hie
worden of er door
wordt meegegeten.

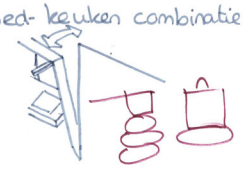
HKJ.
- Hoe kun je over 50 jaar ruimte efficient indelen.

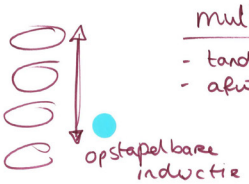
- maak de ruimte multifunctioneel.
- maak van je keukenblad ook je bureau.
- Zorg voor een verplaatsbare keuken
- Maak gebruik van hoogte (bevestiging aan plafond)

de keuken opbergen door hem teverschuiven. In de muur?
↳ inklappen

geen keuken → afhalen
↳ alleen opwarm unit

Inklapbare bed-keuken combinatie





opstapelbare inductie

natte ruimtes combineren

multi functie
- tanden poetsen in keuken
- afwassen in bad.

en combineren ?

Kookplaat in lade

Verwisselen voor vaatwas

de uitgaande energie van het koken terug opwekken.

gekookt water in verwarming

gebruikt worden s wat een tafel heeft.

Slim gebruik van energie

Slimme pannen

Gedeelde keuken met buren

te inductie als aanrecht blad

plaat

Leen inductie

Leasen van kookplaat

Zelf kook restaurant

Pay per use

veel

kant en klaar

veel vriesruimte nodig

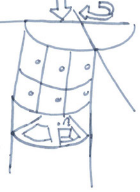
voor zoveel mensen tegelijk koken?

hele grote pannen

kooktoren midden in een appartementencomplex.

minder eten

pp. (Liever niet (=)



samen koken (gezellig!!)

shared kitchen

Febo muur met restjes

(voor de hele straat)

D. Ideation module connection