New Product Development for Upcycling and Circular Economy

De Montfort University
Higher Education Innovation Funding project (2022-2023)

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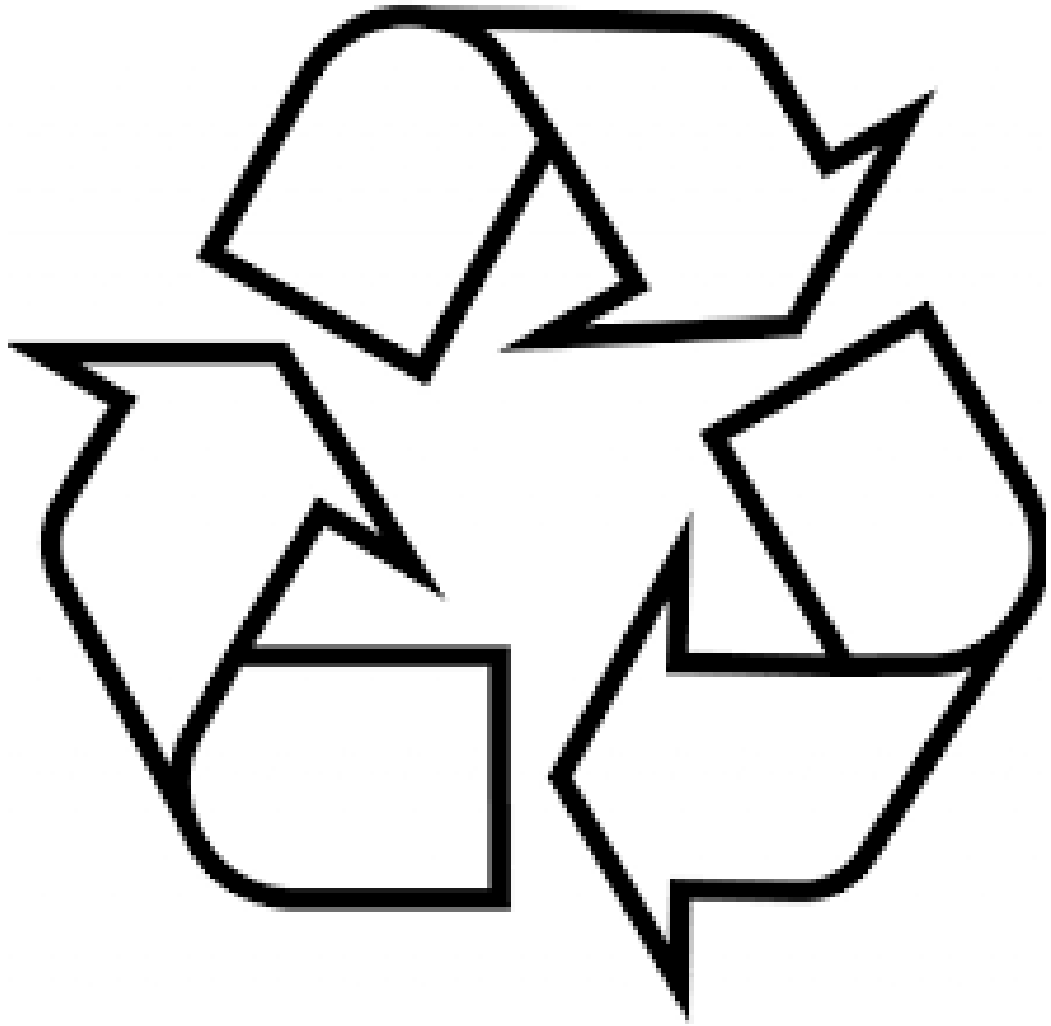
Project Aim

Radical Innovations
Upcycling
Circular Economy

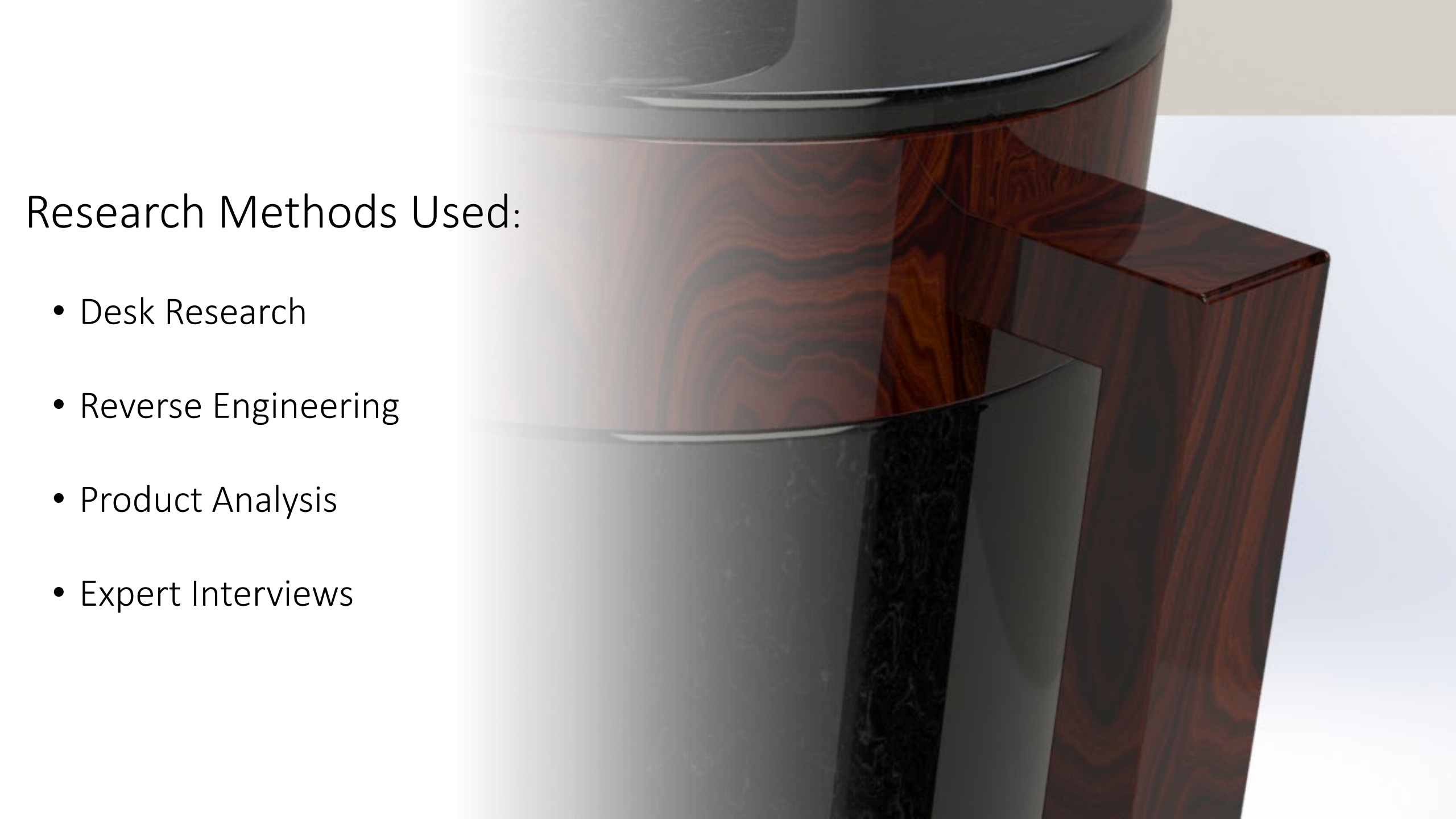


Project Scope

- Focus on electronic products with mixed materials and multiple components.
- Emphasize radical innovation and new product development.
- Align with the principles and practices of upcycling and circular economy.

Research Methods Used:

- Desk Research
- Reverse Engineering
- Product Analysis
- Expert Interviews



Selected Product

BOSCH
Invented for life

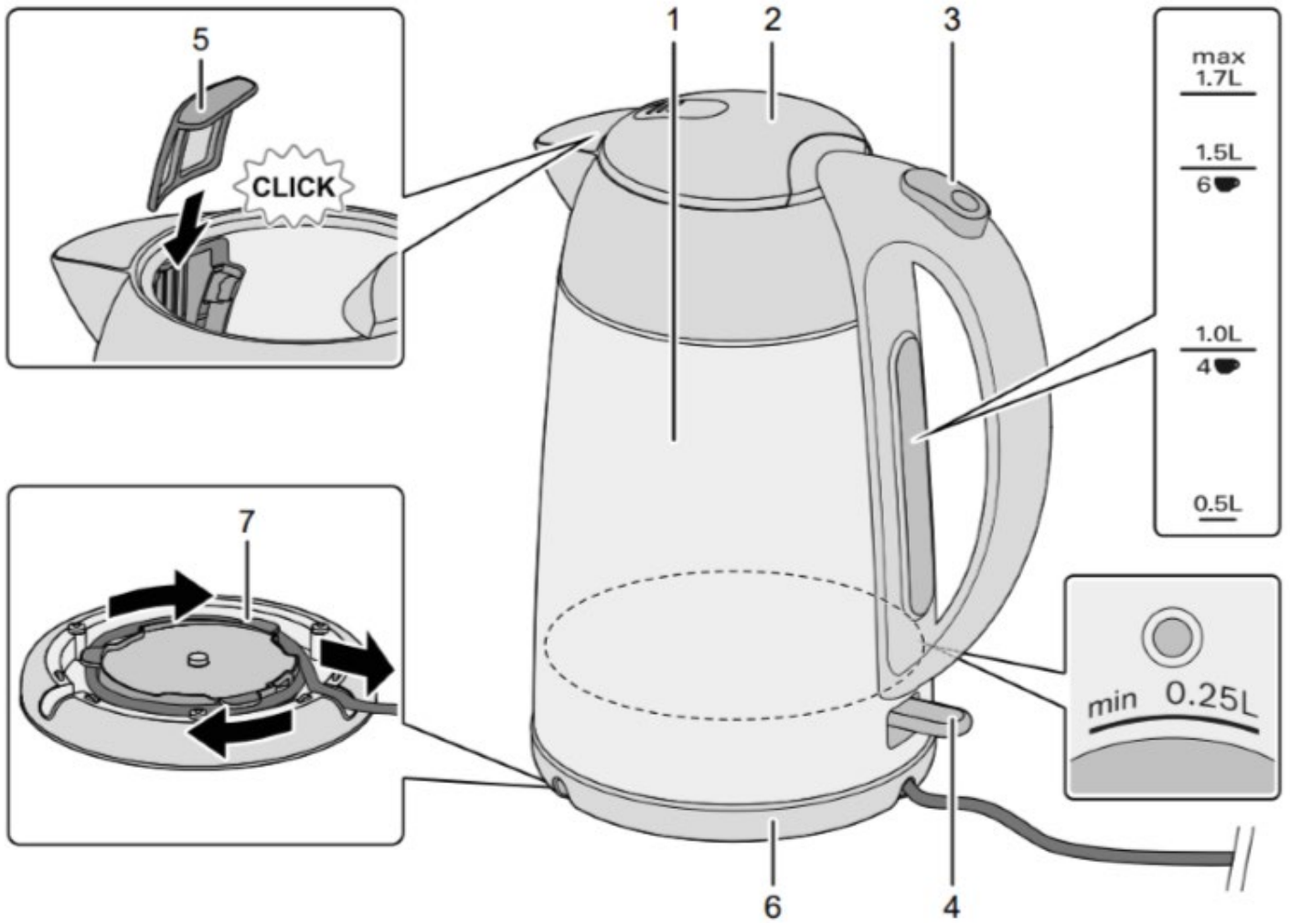
TWK5P475GB 1.7L TraBosch TWK5P471GB 1.7L Traditonal Kettle - White

https://www.amazon.co.uk/Bosch-TWK5P475GB-TraBosch-TWK5P471GB-Traditonal/dp/B08CL5Y6V1/ref=sr_1_12?crid=6W7X4W1HGQIA&keywords=bosch+kettle&qid=1678965221&sprefix=bosh+kettle%2Caps%2C95&sr=8-12

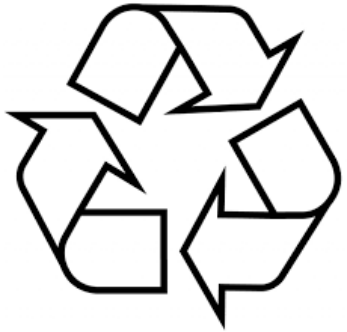
Product Design specifications

Parts and operating controls

1 Kettle (with water level indicator)
2 Lid with lock
3 Lid release button
4 ON/OFF O switch, illuminated
5 Limescale filter (removable)
6 Base
7 Cable tidy



Product disposal and recycle facilities



This appliance is labelled in accordance with

European Directive 2012/19/EU concerning used electrical and electronic appliances (waste electrical and electronic equipment – WEEE).

The guideline determines the framework for the return and recycling of used appliances as applicable throughout the EU.

Circular economy

1 | Materials efficiency
2 | Second life

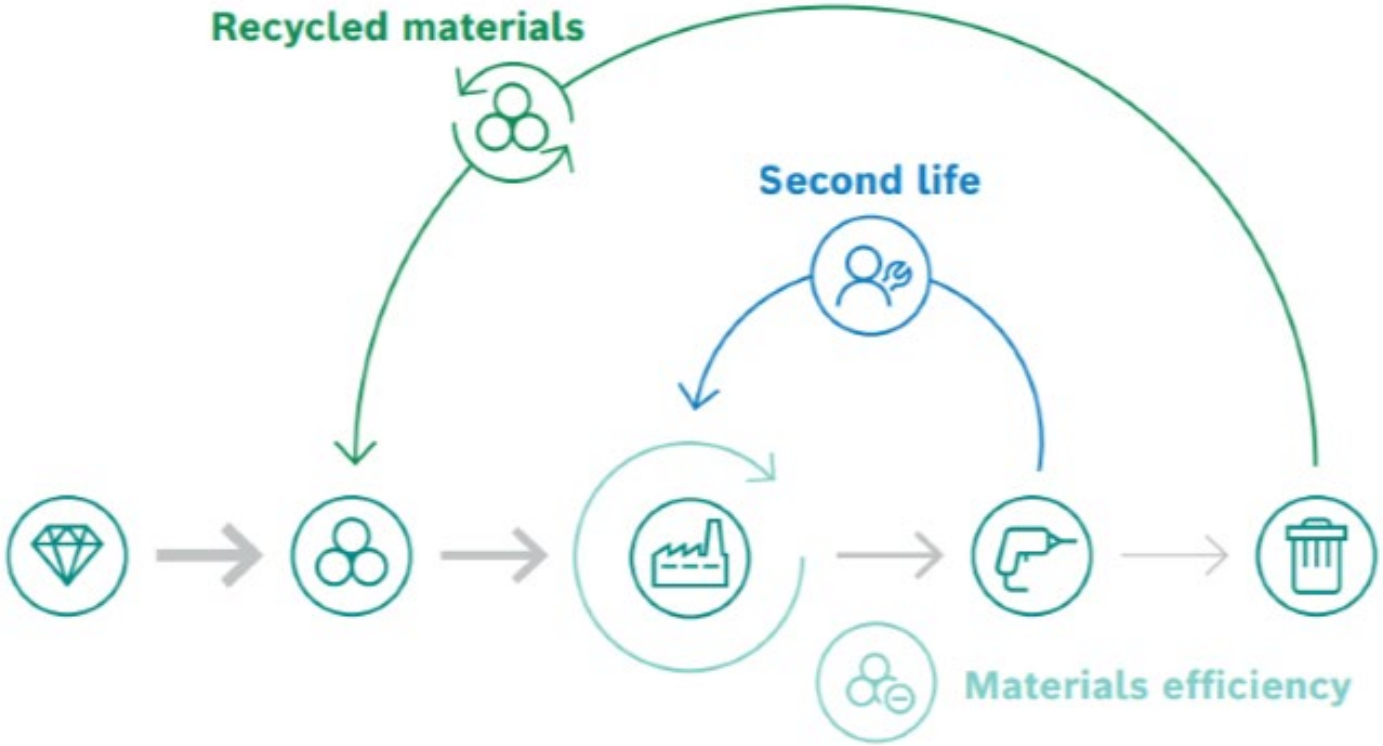
Bosch is reducing its ecological footprint and striving to create social benefit. In this endeavor, Bosch takes its lead from the circular economy principle.

Circular economy

- **Materials**
- Materials efficiency Saving materials by improving materials efficiency

- **Second life**
- Saving materials by extending the product life cycle and reusing materials and components (building a closed-loop system for Bosch products)

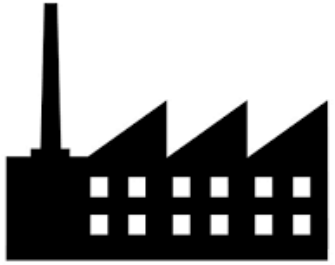
- **Recycled materials**
- Reducing social and environmental impacts by using recycled materials (closing the loop in the economy)



Environmental aspects of Design for Environment

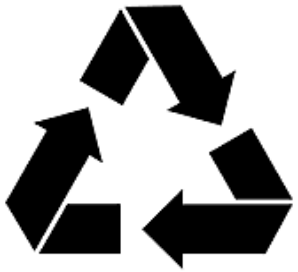
Design and purchasing

- Materials efficiency
- Ability to repair
- Upgradeability
- Secondary and recycled material
- Renewable raw materials
- Avoidance of high-risk raw materials



Manufacturing

- Emissions
- Waste
- Substances of concern
- Hot spot processes



End of life

- Reuse
- Remanufacturing
- Recycling

Initial Project Planning

- Finding competitor products and their design analysis
- Market analysis
- Finding norms and legislation that used for kettle designs
- Analyzing secondary research
- Developing Product design Specification
- Initial Concept Development and prototyping
- Primary research
- Concept selection
- User testing
- Further development
- Prototyping ,simulation and testing
- Presentation slides and models
- Final submission

Target Market of kettle

- **Tea and coffee drinkers:**
- Homeowners
- Office workers
- College students
- Travelers

- **Upcycled kettle users**
- Environmentally conscious consumers
- Health-conscious consumers
- Sustainable lifestyle enthusiasts
- Budget-conscious consumers

Defining The Target Market – **STUDENTS IN UK**

1

Large market size: For academic year 2021/2022 there are approximately **2.5 million student**s enrolled in higher education in the UK according to the Higher Education Statistics Agency (HESA). This represents a large and potentially lucrative market for upcycling products that meet the needs and preferences of students.

2

Growing interest in sustainability: College students are often at the forefront of social and environmental activism, with many expressing concern about issues such as climate change and waste reduction. Targeting students with a product that **aligns with their values and interests** can help to build a strong and loyal customer base.

3

Early adoption: College students tend to be early **adopters of new technologies and products**, making them an ideal demographic to target for a new and innovative upcycling product.

4

Brand loyalty: If you can build a strong brand and reputation among college students, you may be able to establish long-term brand loyalty that can extend beyond the college years and into **their post-college lives**.

5

Influence on others: College students can also have a significant **influence on their peers and social networks**, meaning that if you can successfully engage and attract a core group of student customers, you may be able to leverage this influence to reach a wider audience.

Survey question Stress points

- What **features and functions** do you think are most important in a kettle?
- How important is sustainability and **environmental responsibility** when choosing a kettle?
- What factors **influence your decision** to purchase a kettle, such as price, quality, brand, or design?
- Have you ever **owned a kettle that broke** or became obsolete? What happened to it?
- Would you be **willing to pay a premium** for a kettle that is more sustainable and eco-friendlier?
- What do you think are the **biggest challenges** facing the kettle industry in terms of sustainability and circular economy?
- Do you have any suggestions for how the kettle industry can reduce waste and conserve resources throughout the **product lifecycle**?
- How important is **repairability and recyclability** when **choosing a kettle**?
- What other appliances or products do you think could benefit from circular economy principles?
- Are you **aware** of any other companies or initiatives that are working towards a more **circular economy for household appliances**?

Identify Customer Needs

Environmentally friendly materials: Students may be looking for a kettle that is made from sustainable or upcycled materials, such as recycled metals or plastics, that can reduce waste and environmental impact.

Portable and compact design: College students often live in small spaces, such as dorm rooms or shared apartments, and may need a kettle that is portable and compact, with features such as a detachable handle or foldable design.

Fast boiling time: Students may prioritize a kettle that can boil water quickly, allowing them to prepare their tea or coffee more efficiently before heading to class or studying.

Energy efficiency: An energy-efficient kettle that uses less electricity or has a lower wattage can help students save on energy costs and reduce their environmental footprint.

Easy to clean and maintain: Students may also appreciate a kettle that is easy to clean and maintain, with features such as a removable filter or self-cleaning function.

Innovative features: Depending on the target audience, students may be interested in innovative features that set the kettle apart from competitors, such as a built-in timer, temperature control, or automatic shut-off function.

Defining the product

In the context of the circular economy, a kettle can be designed to be more sustainable and eco-friendlier

- Made from recycled or upcycled materials
- Durable and long-lasting
- Energy-efficient
- Repairable and recyclable
- Compatible with renewable energy sources

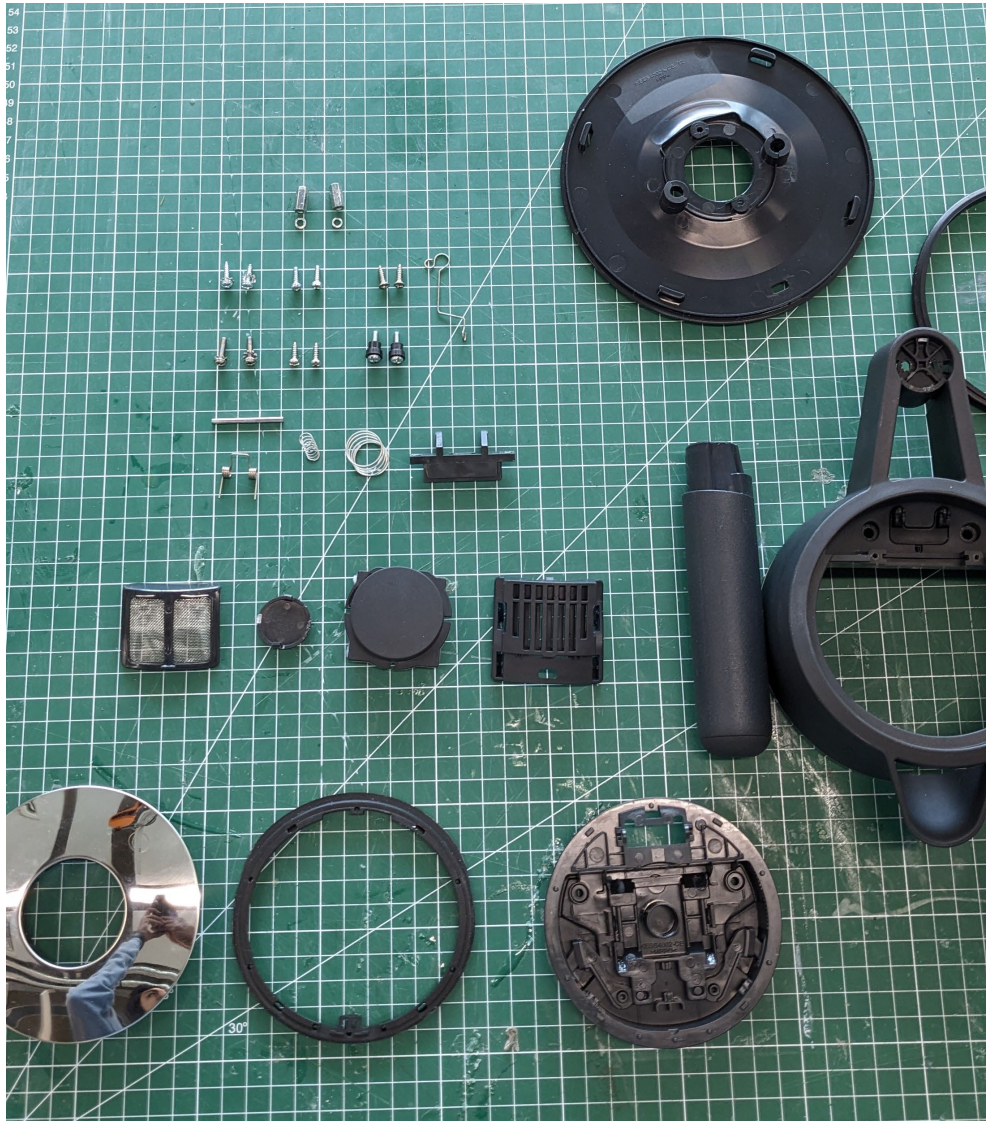
- Manufactured using sustainable and ethical practices

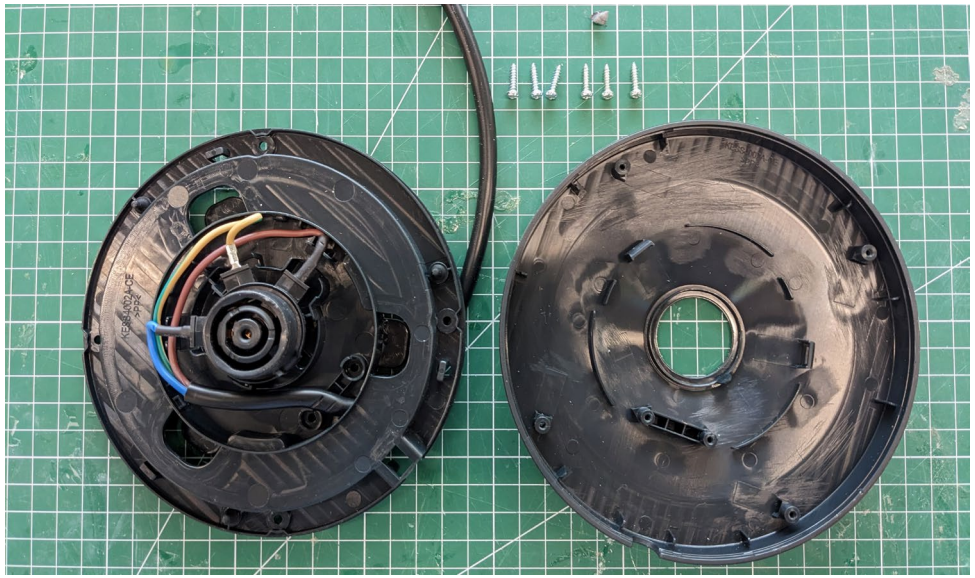
  such as using renewable energy, minimizing waste and emissions

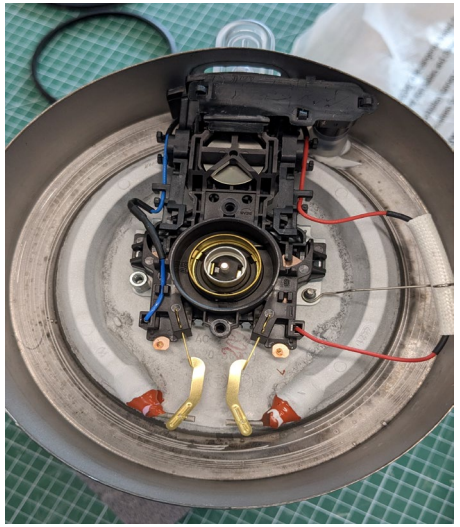
- Minimizes energy consumption and reduces waste

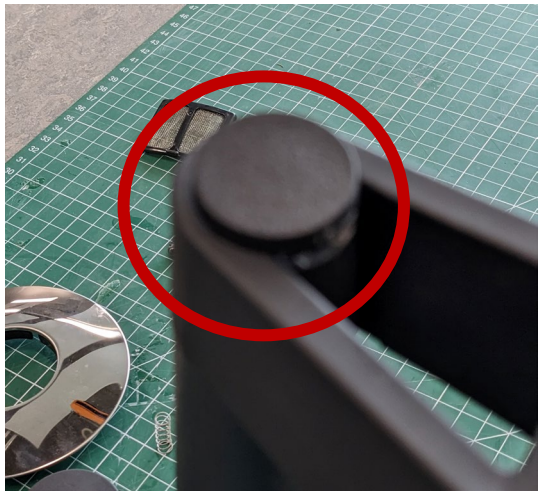
  such as filling only the necessary amount of water and using renewable energy sources to power it.

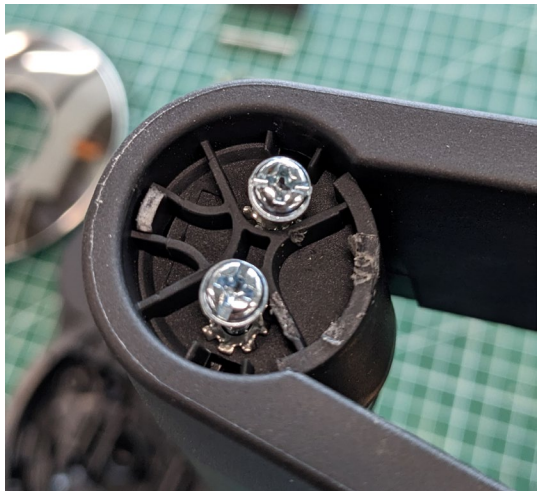
Reverse engineering

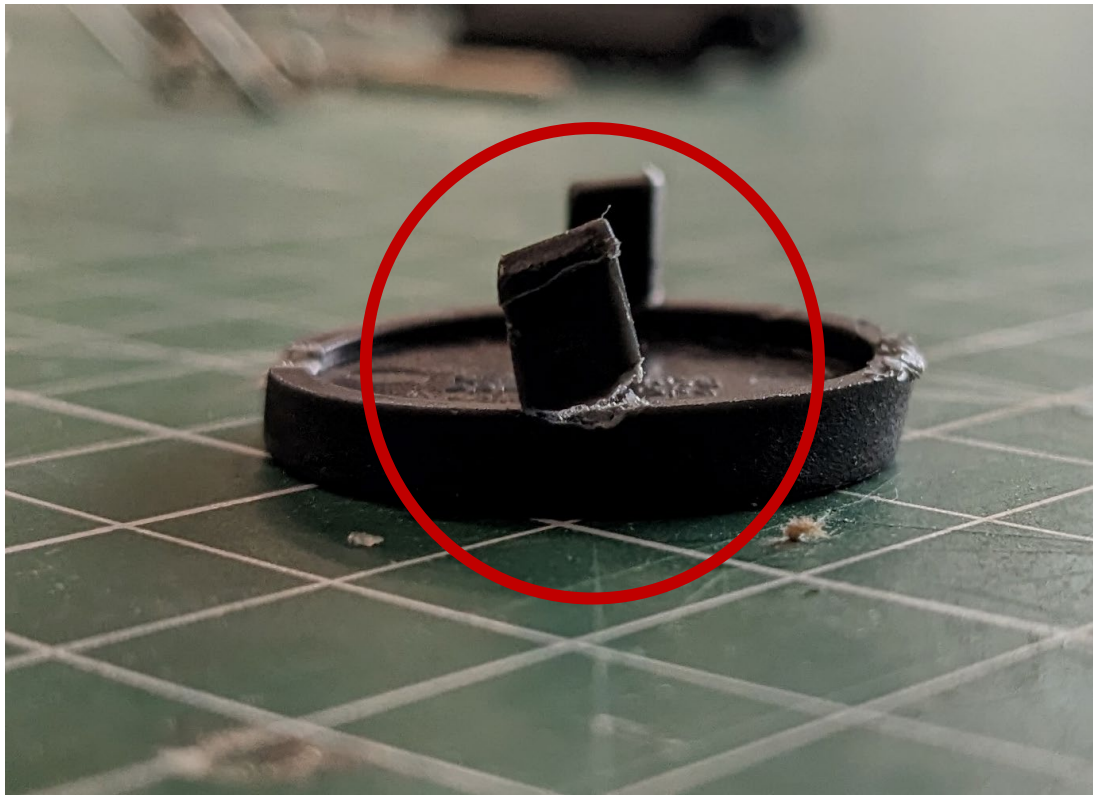










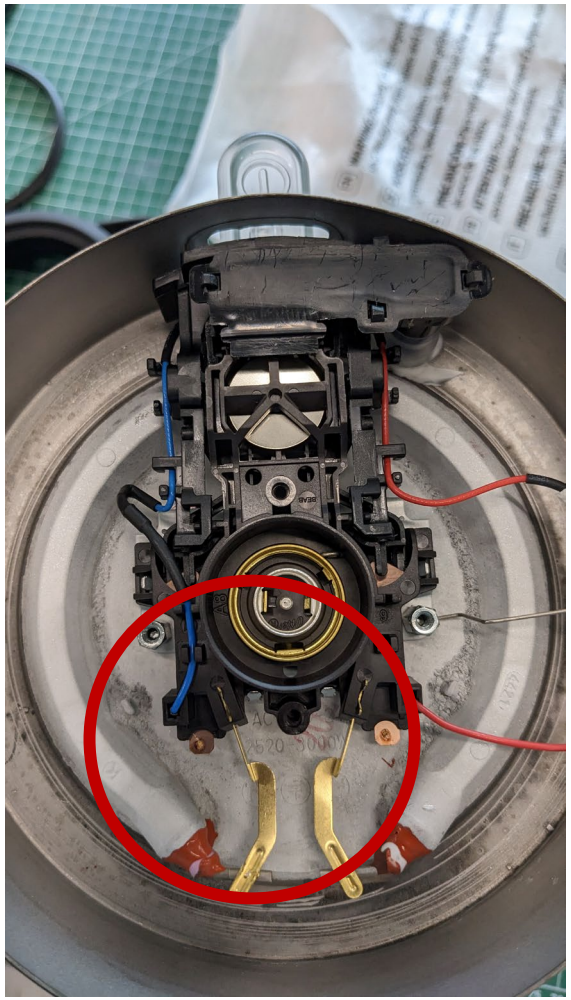


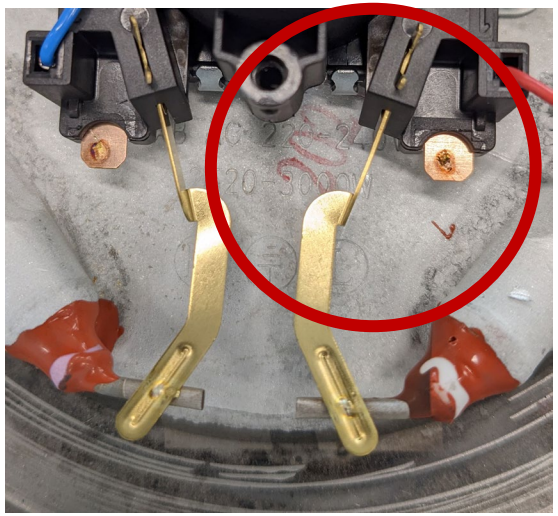
Difficulties faced

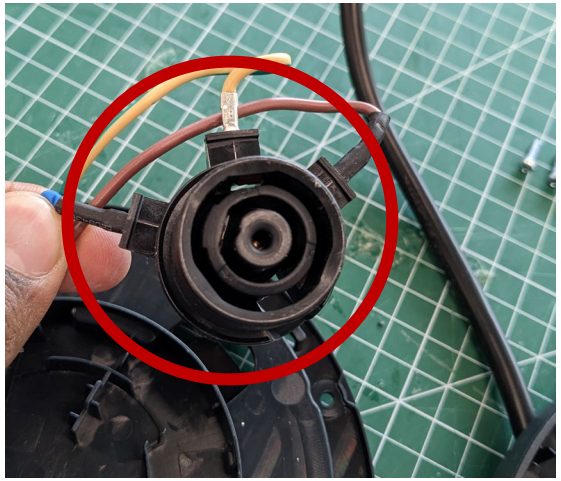
- Press fit components no accessibility.
- Less durable material.

Preferred solutions

- Better access for removal.
- Material selectin (considering Bioplastics)





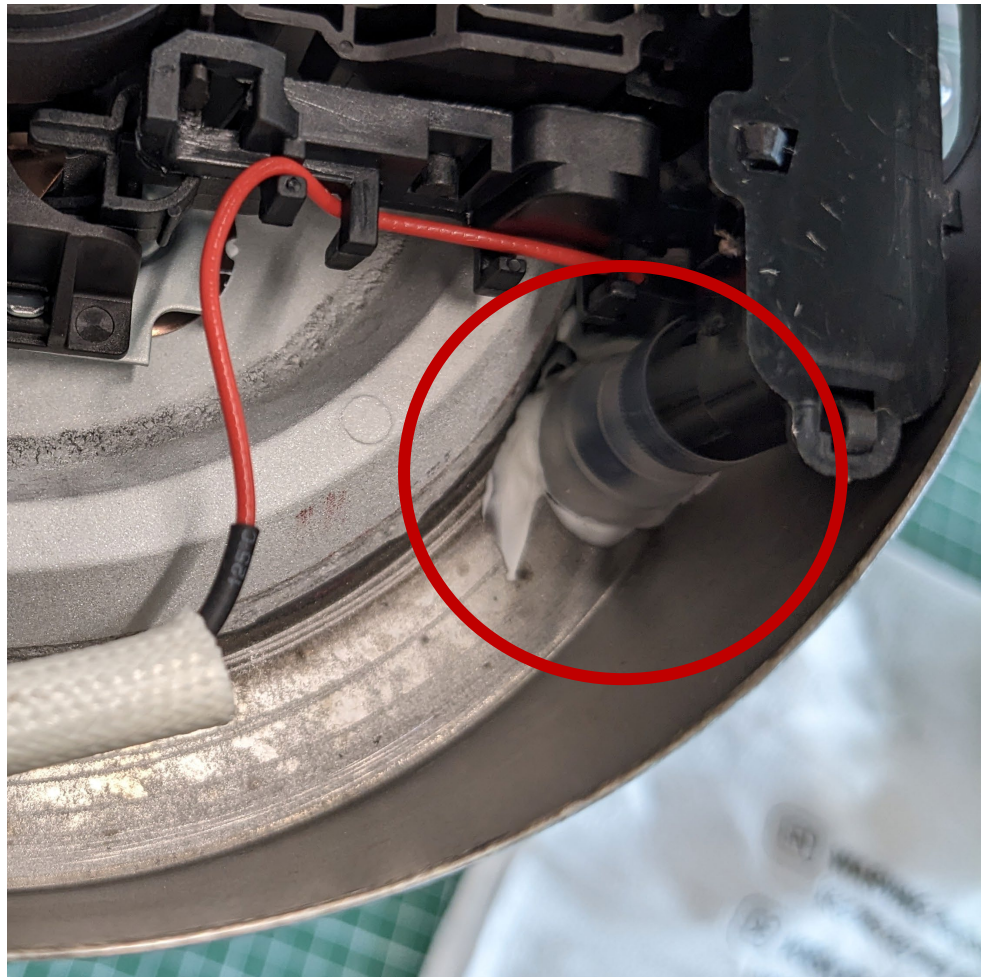


Difficulties faced

- Heating coil seems to be welded to the container part removal or replacing is not possible.
- Copper strips are also not removable
- Most of the electrical wirings are also not removable

Preferred solutions

- Fastened with screws or nails.
- Clamps
- Spring steel clips

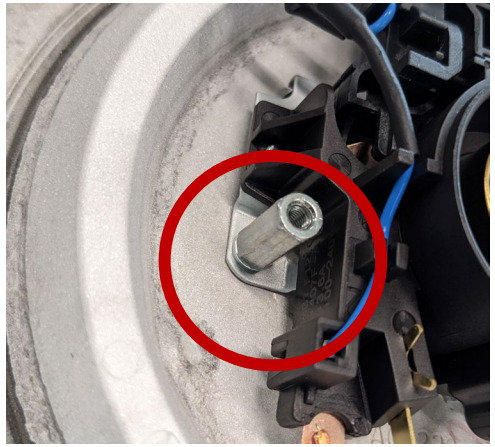


Difficulties faced

- Some parts are glued together.

Preferred solutions

- Can use press fit methods

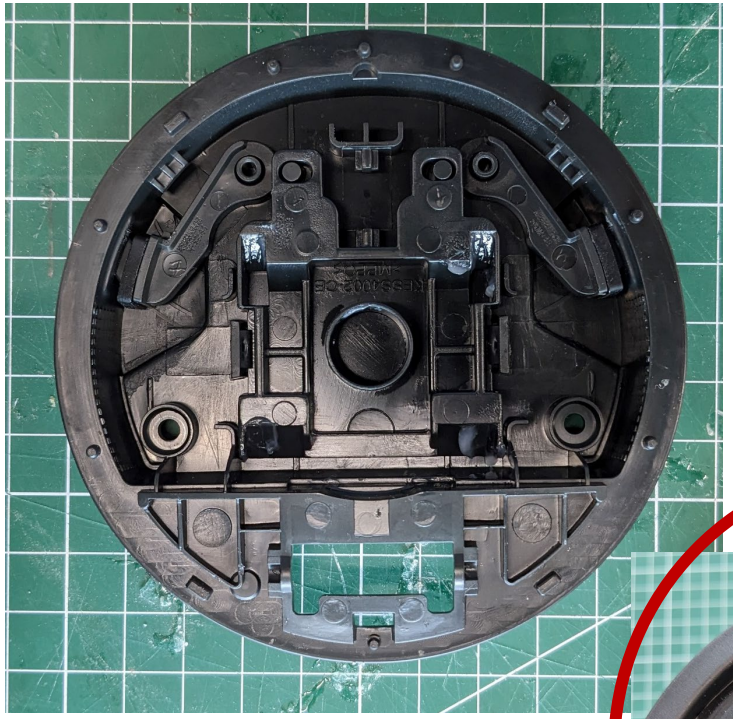


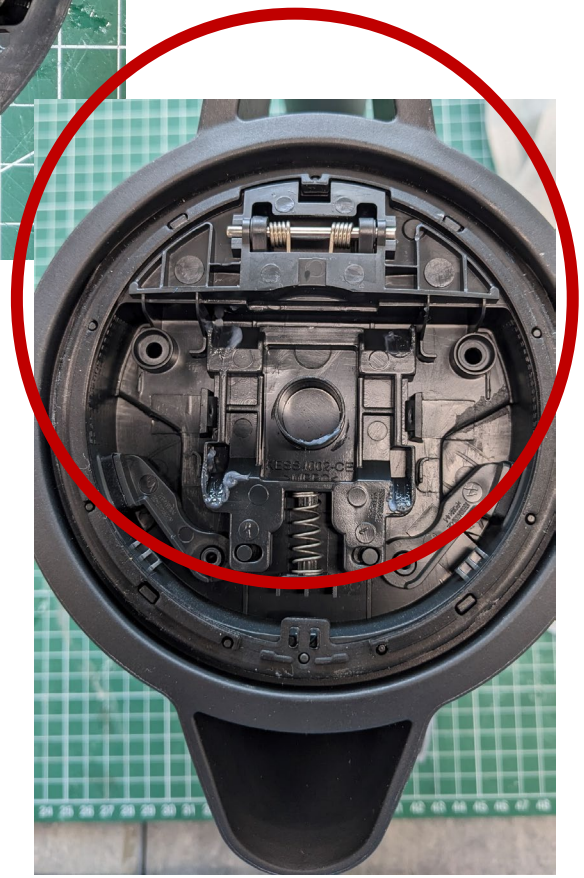
Difficulties faced

- Some fasteners need special tools to remove them makes the design hard to maintain

Preferred solutions

- Slight changes in design





Difficulties faced

- Complicated mechanism and too many parts for closing the lid.
- Material selection

Preferred solutions

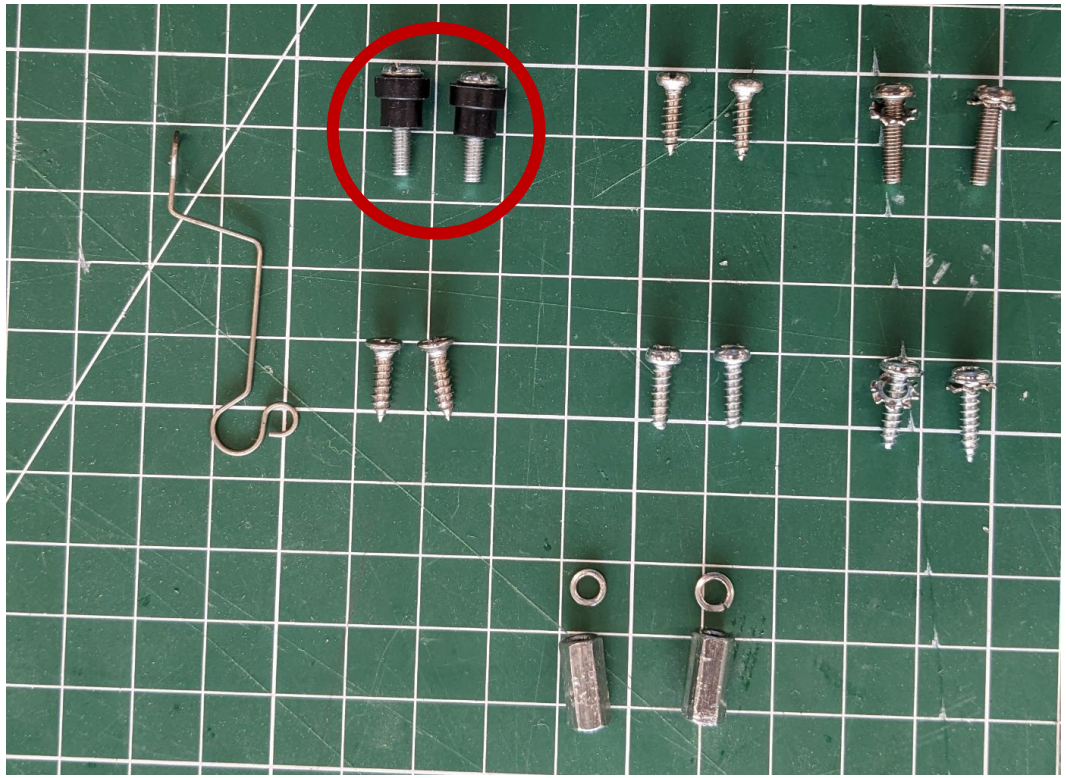
- Redesign the lid closing mechanism
- Selection of material

Difficulties faced

- Water level indicator need special type tools, too hard to remove.
- Material is not elastic and getting deformation when tries to remove.

Preferred solutions

- Find new mechanism to attach to the container.
- Replace material.



Difficulties faced

- More than 8 types of fasteners need more tools, some of them were special types .
- Some screws are integrated with some unique plastic parts.

Preferred solutions

- Standardisation of fasteners as possible

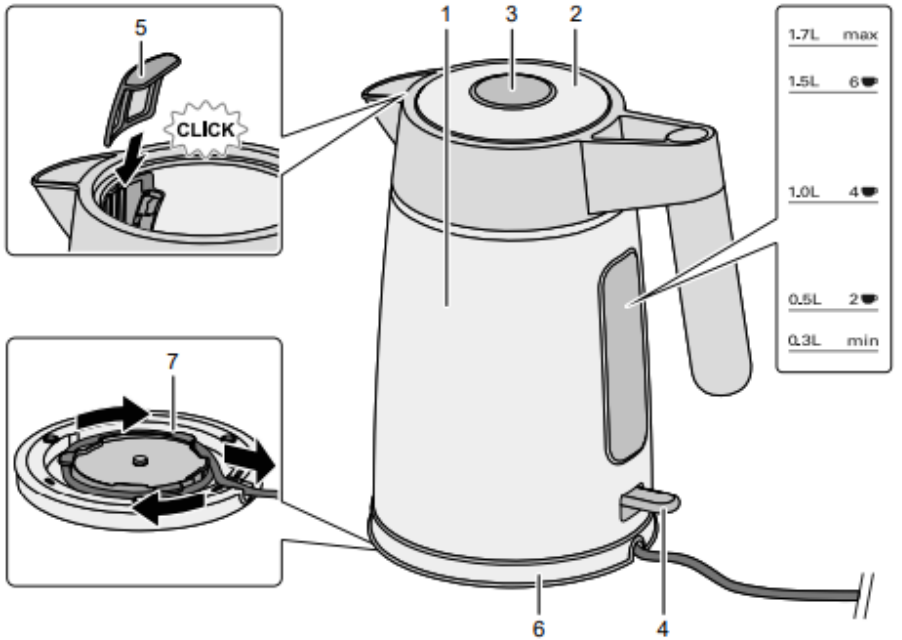
Stakeholders review

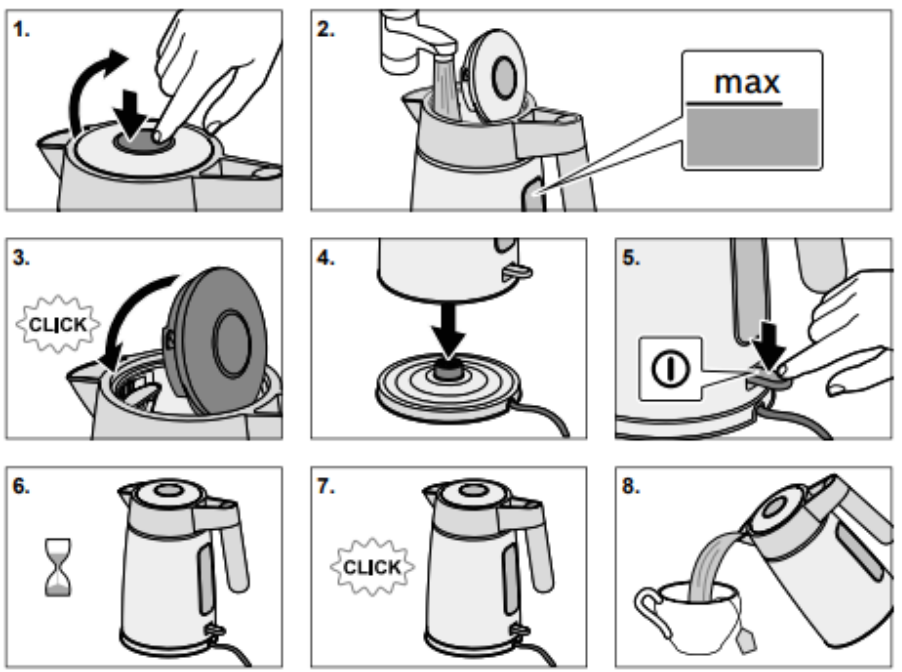
- Standardization of fasteners for easier disassembly and repair
- Redesigning the lid closing mechanism to simplify it and reduce the number of parts
- Exploring alternative materials for the water level indicator that are elastic and less prone to deformation
- Using sustainable and recyclable materials for the kettle design
- Incorporating a plug-and-play mechanism for easy electrical connections
- Considering the use of fasteners and clamps instead of adhesive for better repairability
- Exploring the concept of interchanging outer shells to personalize the kettle's aesthetics while keeping the inner working parts standardized

Analysis of Existing Electronic Products

Common parts in a kettle

- Body or Vessel
- Heating Element
- Lid
- Spout (The narrow opening from which the hot water is poured)
- Handle
- Power Switch
- Water Level Indicator
- Base (The platform on which the kettle sits and connects to the power supply)
- Electrical cord
- Control Mechanism





Interchangeable parts in kettle

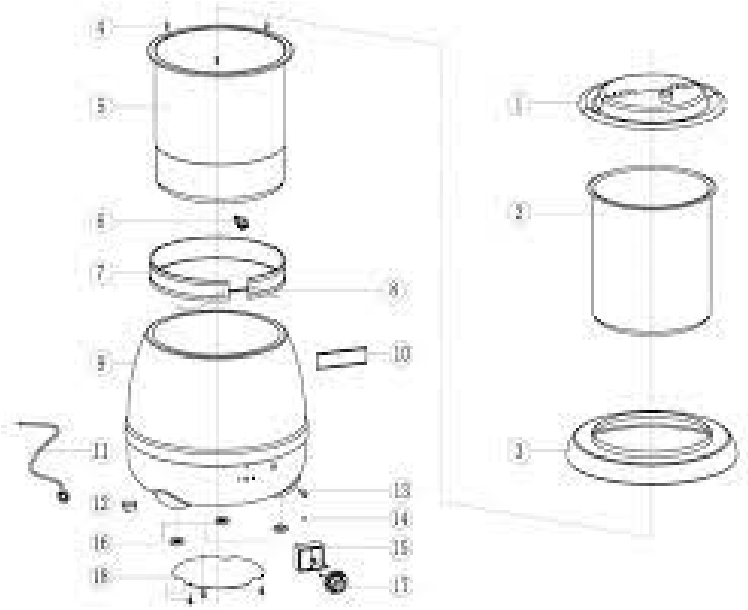
Thermostat

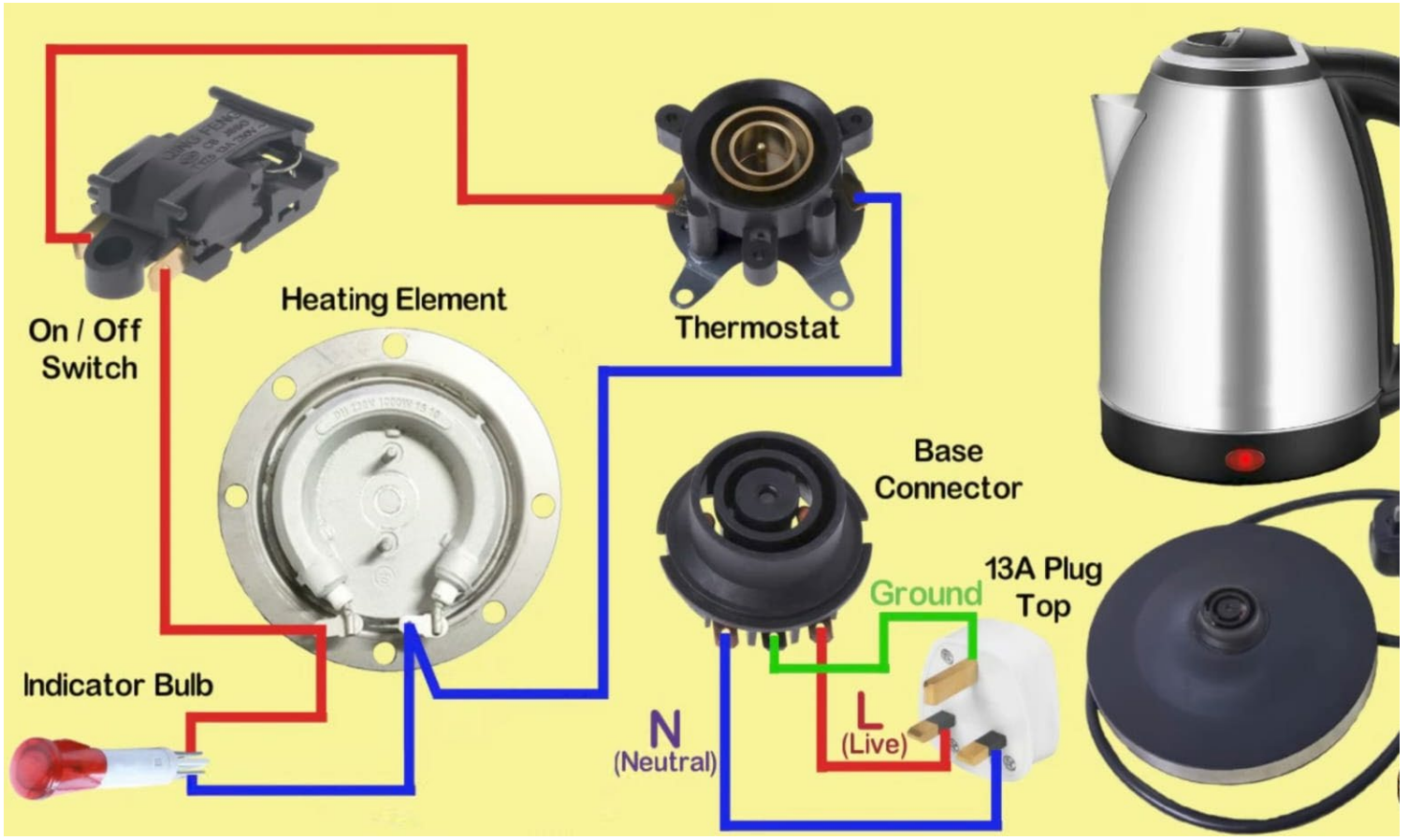
Electrical Kettle Base Connector

Thermostat switch base connector

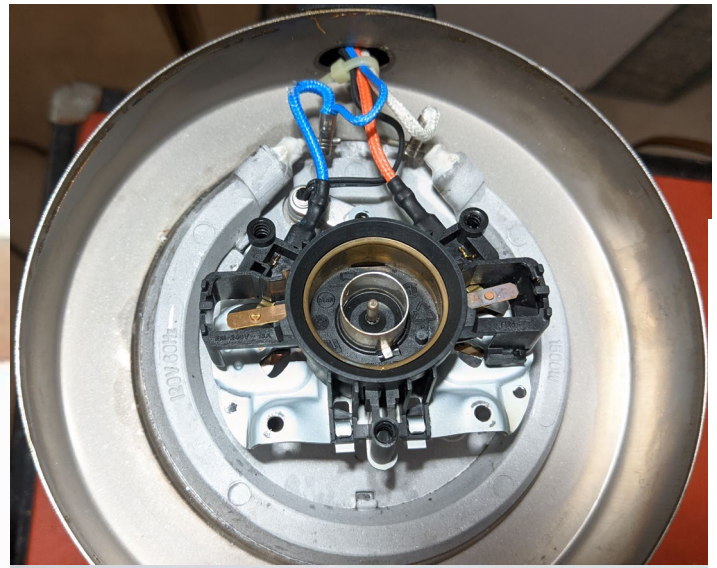
Kettle Filter

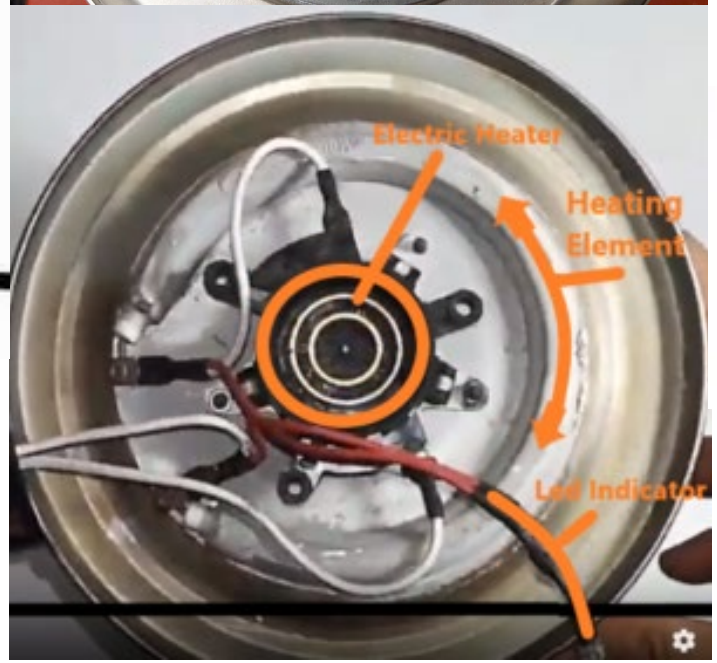
Button SWitch




On / Off
Switch
Heating Element
Thermostat
Base
Connector
Indicator Bulb
Ground
13A Plug
Top
N
(Neutral)
L
(Live)

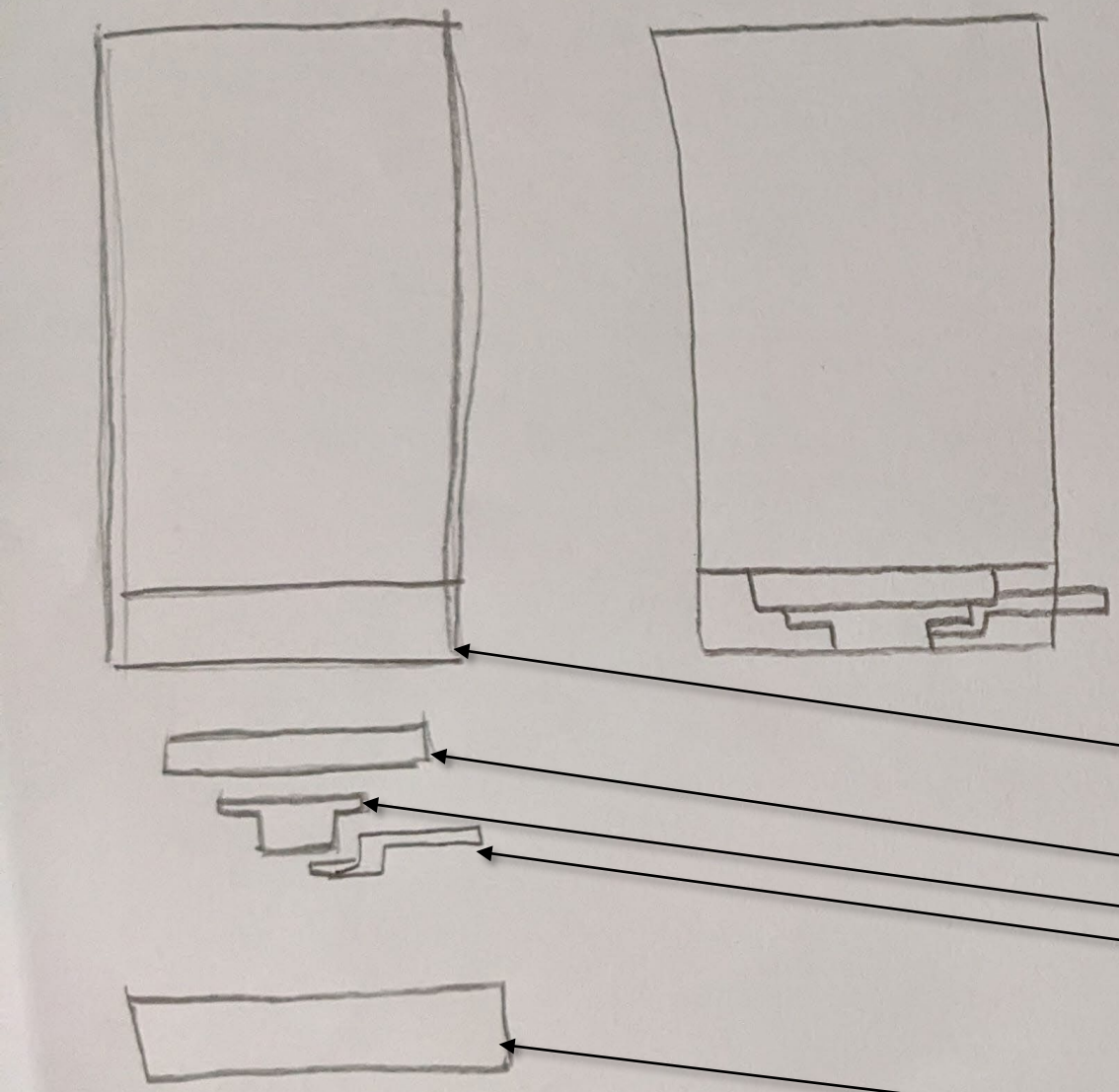
Design Challenges - Handlebar switches





Proposed Radically New Products for Upcycling and Circular Economy

- Ideas, Concepts, and Designs



Considerations and potential challenges to keep in mind:

Compatibility: defining standard dimensions, attachment points, and interfaces that can accommodate different shell designs.

Structural Integrity: load-bearing capacity, stability

Alignment and Fit: Achieving proper alignment and fit between the inner vessel, working mechanisms, Precise tolerances, and locking mechanisms

Accessibility and Serviceability: Maintenance, repair, and potential future upgrades. incorporating features like removable panels

Manufacturing and Production: Material selection, manufacturing processes, assembly techniques, and cost-effectiveness

User Experience:
functionality, or safety of the product. Ergonomics, and user interface

Alternative sustainable materials

- Glass
- Ceramic

Design Inspirations

Thermal expansion:

Ceramic and steel have different thermal expansion coefficients, meaning they expand and contract at different rates when subjected to temperature changes. To accommodate this, it is important to design the joint in a way that allows for some flexibility and prevents stress or cracking. This can be achieved by incorporating a flexible gasket or using a joint design that allows for slight movement without compromising the seal.

Gasket or sealant:

Using a high-temperature gasket or food-safe sealant can help create a secure and watertight connection between the ceramic vessel and the steel bottom plate. These materials should be selected to withstand the temperature fluctuations and provide a reliable seal.

Silicone Gaskets:

Silicone gaskets are commonly used in high-temperature applications and can withstand heat up to 500°F (260°C). They offer excellent flexibility and sealing properties, making them suitable for sealing the connection between the ceramic vessel and the steel bottom plate.

Food-Grade RTV Silicone Sealant:

RTV (Room-Temperature Vulcanizing) silicone sealants are widely used in food and beverage industries due to their food-safe properties. They are designed to cure at room temperature, forming a durable and flexible seal. It is important to select a high-temperature variant of the sealant that can withstand the heat generated during kettle operation.

High-Temperature Ceramic Adhesive:

There are specialized ceramic adhesives available that are designed for high-temperature applications. These adhesives can bond ceramic to steel surfaces and withstand the expansion and contraction that occurs due to temperature changes. They provide a strong and long-lasting bond between the two materials.

786 Silicon Sealant Clear 310ml

By Dow Corning

Order Code: ZT1014796X

MFR Part No. * 2825562/C05 | Colour * Clear | Product Composition * One-part, Acetoxy-cur

See 2 More Product Variants

£13.29 Inc VAT (20%)

1 | Add to basket | Add to quotation

Order by 3pm, get it Tomorrow

Create a New Subscription

View all Silicone & Caulk Sealants

Description

Mildew Resistant Silicone Sealant for Refrigeration Units

A one-part, acetoxy, silicone rubber sealant which has excellent adhesion to a variety of surfaces.Contains a food grade fungicide. Ideal for

See full description

Loctite Loctite 595 Transparent Sealant Paste 100 ml Tube

RS Stock No.: **423-6758** | Mfr. Part No.: **229293** | Brand: Loctite

Roll over image to zoom in

iEFiEL 10Pcs Airtight Silicone Gasket Sealing Rings Reusab Food-Grade Rubber Seal for Mason Jar Caning Lids White 2.8 inch

Visit the iEFiEL Store

4.7 ★★★★½ 4 ratings

£8.39

Size Name: **2.8 inch**

2.8 inch £8.39 | 3.44 inch £10.29

Colour Name: **White**

Material	Silicone,Rubber
Colour	White
Brand	IEFiEL
Shape	Round
Dishwasher safe?	Yes

£ 5.89

Color: sus304 500w



Quantity:

1 50 Pieces available

Ships to

Shipping: £2.99

From China to GB via AliExpress Standard Shipping

Zoom

electric kettle heating plate piping round stainless steel electric tea kettle accessories heating eleme...

SKU: 8799116771820

Price

£108.69

MSRP: ~~£130.39~~

Free shipping

17% DISCOUNT

Your selection: 220v 1000w-1500w

220v 2200w | 110v 1200w | 220v 1000w-1500w

1 Add to cart

Free shipping

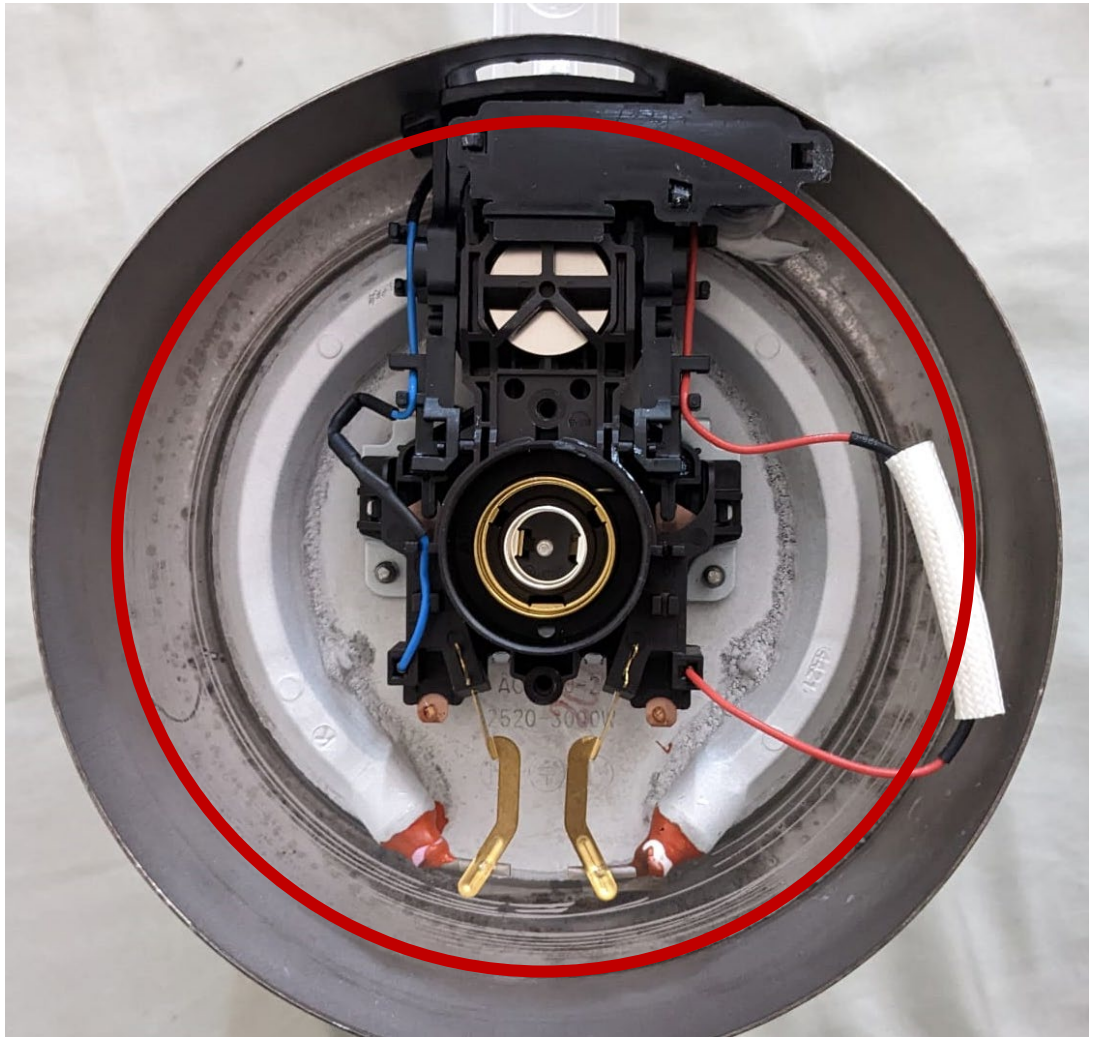
100 days to return

Lowest prices

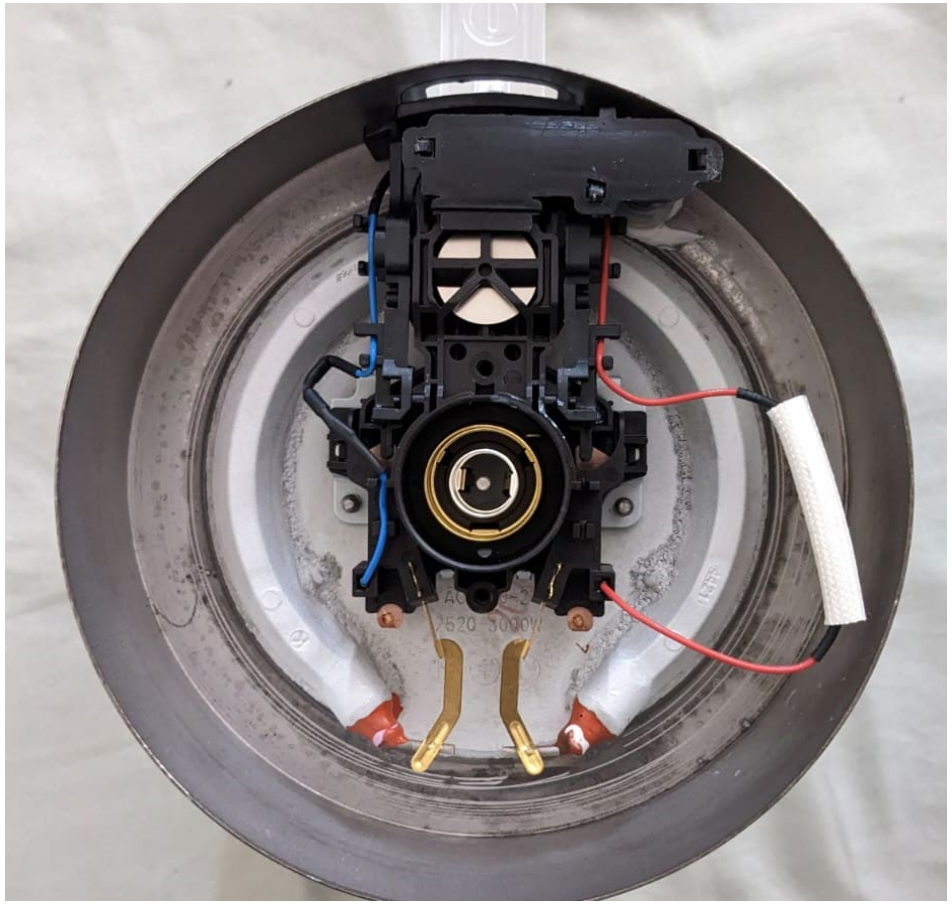
Prototype

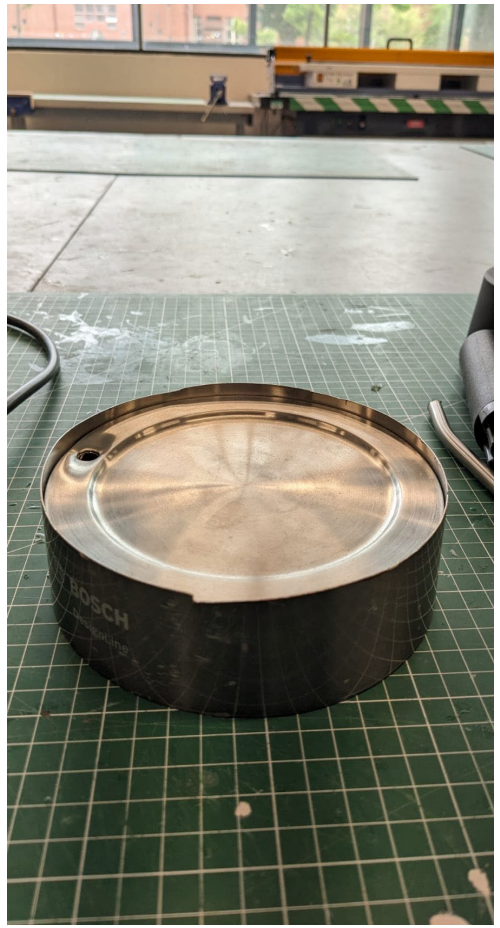
Change in shape

1. Drying
2. Bisque Firing
3. Glazing
4. Final Firing
5. Finishing and Inspection



Since the bottom plate is welded to the stainless-steel vessel, the marked portion must be cut out to replace the vessel with a ceramic one.




BOSCH


BOSCH
DesignLine


BOSCH
DesignLine


DMU CONTOUR

‹ Back to results

Roll over image to zoom in

Silco Silicone RTV 4500 Food Contact Safe High Strength Silicone Sealant, Clear (2.8 FL. Ounce)

Brand: Silco

5.0 ★★★★★ 1 rating

£16.99 (£0.21 / Millilitre)

FREE Returns

Size Name: **Standard**

Material	Rubber
Brand	Silco
Colour	Clear
Style	Compact
Item weight	2.8 Ounces

About this item

- Food Contact Safe 350F high temp
- Impervious to all weather conditions
- Bonds to most surfaces
- Excellent for sealing or creating gaskets
- Self curing, easy to app


BOSCH
DesignLine


BOSCH
DesignLine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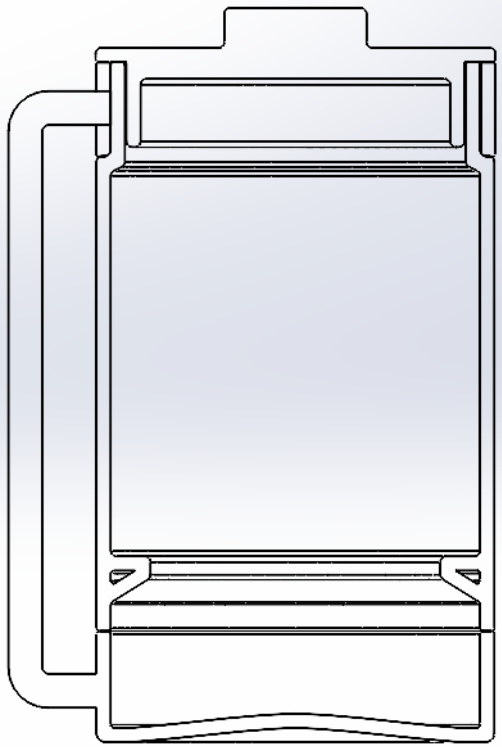
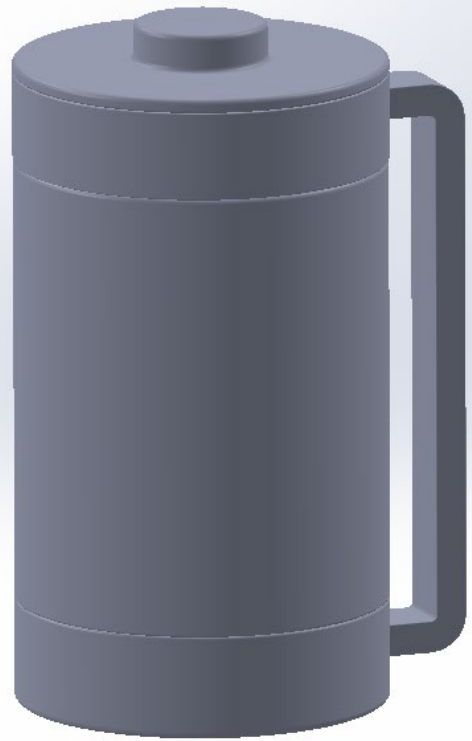
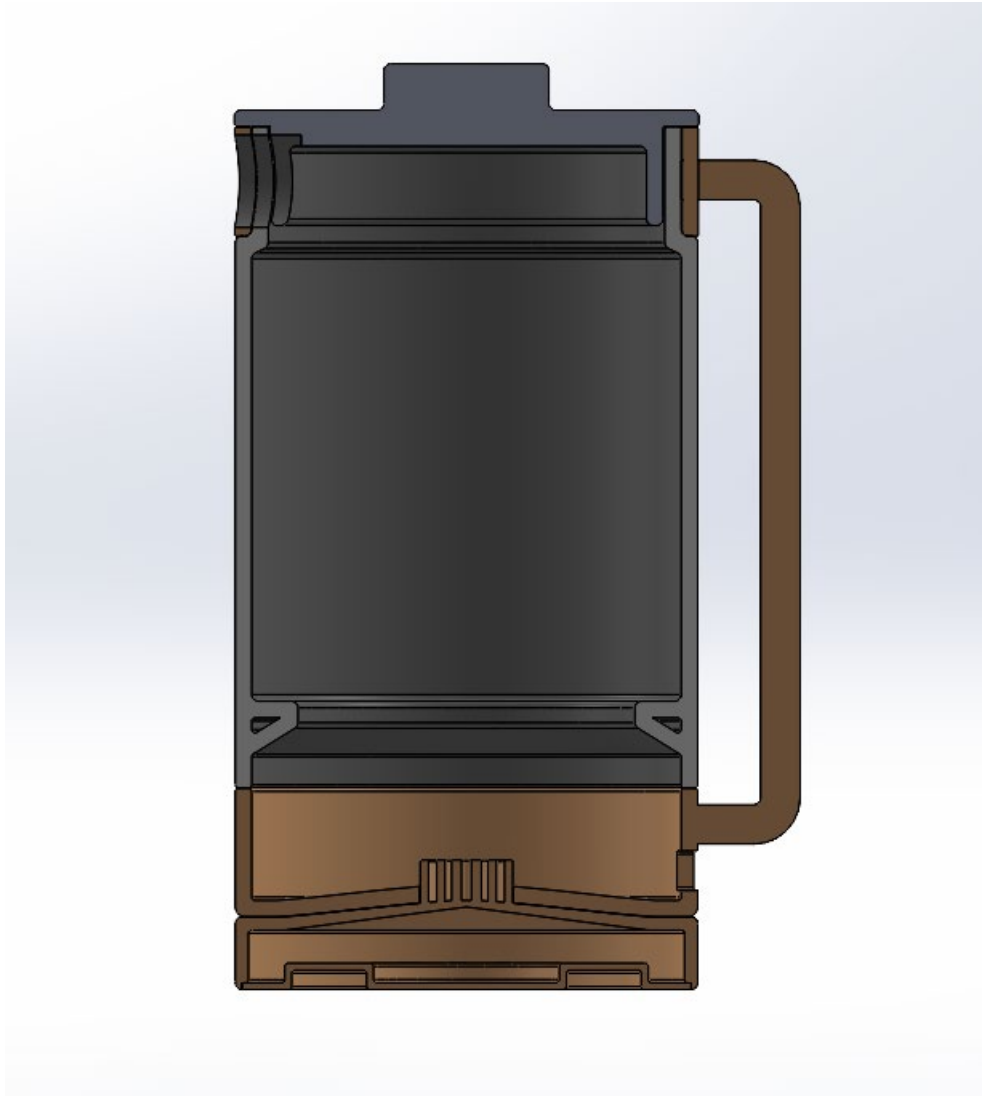
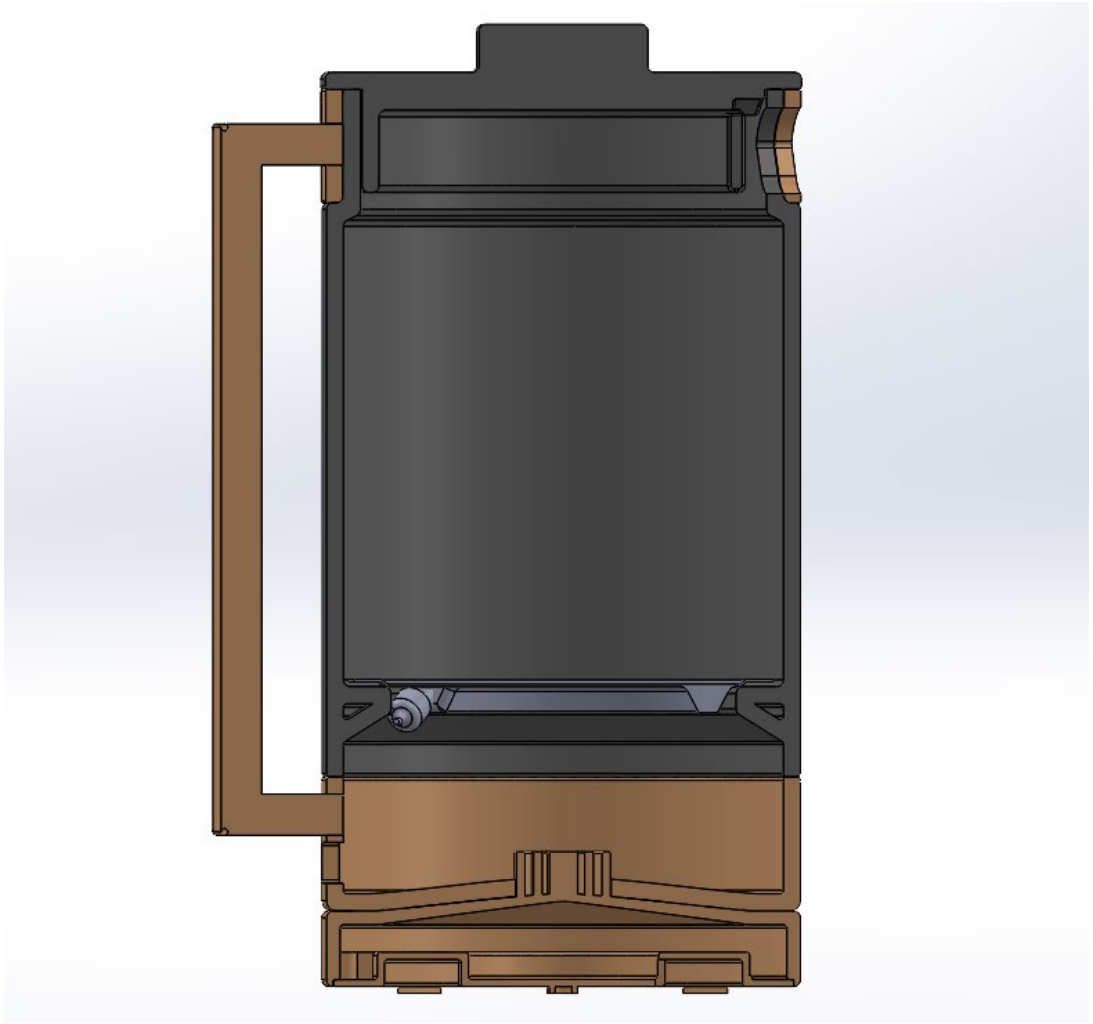
BOSCH
DesignLine

Final Design Concept and ideas









Final Design